



Part I: Project Information

GEF ID

10970

Project Type

FSP

Type of Trust Fund

GET

CBIT/NGI

CBIT No

NGI No

Project Title

Groundwater for Deep Resilience in Africa (G4DR in Africa)

Countries

Regional, Malawi, Mozambique, Uganda, Benin, Togo

Agency(ies)

FAO

Other Executing Partner(s)

African Ministers' Council on Water (AMCOW), International Water Management Institute (IWMI), and International Institute for Applied Systems Analysis (IIASA)

Executing Partner Type

Others

GEF Focal Area

International Waters

Sector

Taxonomy

Focal Areas, International Waters, Freshwater, Aquifer, River Basin, Pollution, Nutrient pollution from Wastewater, Nutrient pollution from all sectors except wastewater, Transboundary Diagnostic Analysis and Strategic Action Plan Preparation, Influencing models, Strengthen institutional capacity and decision-making, Demonstrate innovative approach, Stakeholders, Private Sector, Beneficiaries, Type of Engagement, Consultation, Partnership, Participation, Information Dissemination, Communications, Education, Awareness Raising, Civil Society, Community Based Organization, Non-Governmental Organization, Academia, Local Communities, Gender Equality, Gender Mainstreaming, Gender-sensitive indicators, Gender results areas, Participation and leadership, Capacity Development, Capacity, Knowledge and Research, Enabling Activities, Knowledge Exchange

Rio Markers

Climate Change Mitigation

No Contribution 0

Climate Change Adaptation

Significant Objective 1

Biodiversity

No Contribution 0

Land Degradation

No Contribution 0

Submission Date

6/19/2023

Expected Implementation Start

1/1/2024

Expected Completion Date

12/31/2027

Duration

48In Months

Agency Fee(\$)

549,677.00

A. FOCAL/NON-FOCAL AREA ELEMENTS

Objectives/Programs	Focal Area Outcomes	Trust Fund	GEF Amount(\$)	Co-Fin Amount(\$)
IW-1-3	IW 3.5 Enhance water security in freshwater ecosystems through advance information exchange and early warning	GET	1,700,000.00	8,826,278.00
IW-1-3	IW 3.6 Enhance water security in freshwater ecosystems through enhanced regional and national cooperation on shared freshwater surface and groundwater basins	GET	2,100,000.00	8,489,544.00
IW-1-3	IW 3.7 Enhance water security in freshwater ecosystems through investments in water, food, energy and environment security	GET	1,986,073.00	28,167,524.00
Total Project Cost(\$)			5,786,073.00	45,483,346.00

B. Project description summary

Project Objective

To enhance water security and resilience in Africa by unlocking the potential of sustainable groundwater development and protection.

Project Component	Financing Type	Expected Outcomes	Expected Outputs	Trust Fund	GEF Project Financing(\$)	Confirmed Co- Financing(\$)
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Project Component	Financing Type	Expected Outcomes	Expected Outputs	Trust Fund	GEF Project Financing(\$)	Confirmed Co-Financing(\$)
Component 1 Strategic Planning: Supporting the African Ministers' Council on Water (AMCOW), through their Pan-African Groundwater Program (APAGroP), to strengthen planning and investment that incorporates groundwater.	Technical Assistance	<p>Outcome 1.1: Enhanced capacity and sustainability of the AMCOW Secretariat to execute its mandate to support Regional Economic Communities (RECs), River Basins Organization (RBOs) & Member States (MSs) in achieving groundwater-based water security and resilience.</p> <p>Outcome 1.2: Greater resilience to shocks through increased capacity and use of tools to assess groundwater quantity and quality.</p> <p>Outcome 1.3: Environments that enable & support</p>	<p>Output 1.1.1: Sustained AMCOW Groundwater Desk as an anchor institution for APAGroP and G4DR objectives.</p> <p>Output 1.2.1: Tools to guide strategic investment in groundwater.</p> <p>Output 1.3.1: Adoption & application of policy guidelines on groundwater use and management, co-developed with multisectoral actors.</p> <p>Output 1.4.1: Africa-wide Groundwater Strategy & Coordinative Framework that is driven by data and supported through a 'Hub and Spoke' model between AMCOW and regional centres (Southern African Development Community</p>	GET	1,354,058.00	5,078,671.00

Project Component	Financing Type	Expected Outcomes	Expected Outputs	Trust Fund	GEF Project Financing(\$)	Confirmed Co-Financing(\$)
		management of groundwater opportunity and risk. Outcome 1.4: Coordinated multi-scale approach to groundwater planning in Africa.	(SADC) ? Groundwater Management Institute (GMI) - Sahara and Sahel Observatory (OSS) ? Intergovernmental Authority on Development (IGAD).			
Component 2 Evidence and capacity for G4DR in Africa: Identifying areas in Africa that present groundwater-related risks and opportunities for enhancing water security and resilience.	Technical Assistance	Outcome 2.1: More informed decision making on groundwater-related risks and opportunities under present and future climate and development scenarios. Outcome 2.2: RECs, RBOs, MSs capacitated in groundwater assessment tools and approaches.	Output 2.1.1 Knowledge products, information, and policy products that map groundwater-related risks and opportunities to water security and resilience. Output 2.2.1 Joint learning and exchange on sustainably assessing quantity and efficiently approaching groundwater quality, and potential risks of groundwater.	GET	710,000.00	6,650,955.00

Project Component	Financing Type	Expected Outcomes	Expected Outputs	Trust Fund	GEF Project Financing(\$)	Confirmed Co-Financing(\$)
Component 3 Demonstrating benefit: Utilizing evidence-based planning to realize on-the-ground impacts in pilots.	Technical Assistance	<p>Outcome 3.1: Evidence-driven transboundary groundwater management in the Shire aquifer system.</p> <p>Outcome 3.2: Groundwater integrated into catchment planning in Uganda.</p> <p>Outcome 3.3: Supporting integrated aquifer management & Reducing groundwater risks in the Shared Mono Basin.</p> <p>Outcome 3.4: Decision-making on prioritization of groundwater investments enhanced.</p>	<p>Output 3.1.1: Gender, Indigenous Peoples presence and water assessment for the transboundary Shire aquifer system.</p> <p>Output 3.1.2: Design of harmonized groundwater monitoring network, rehabilitation of non-functional wells and targeted new borehole drilling.</p> <p>Output 3.1.3: Data logger installation in selected boreholes and analysis of measured data.</p> <p>Output 3.1.4: Water quality monitoring and laboratory analysis.</p> <p>Output 3.1.5: Shared data platform to support improved aquifer planning.</p>	GET	2,664,336.00	28,705,813.00

Project Component	Financing Type	Expected Outcomes	Expected Outputs	Trust Fund	GEF Project Financing(\$)	Confirmed Co-Financing(\$)
			<p>Output 3.2.1: Tools and evidence base for managing and planning groundwater in the Upper Nile Water Management Zone (UNWMZ) of Uganda.</p> <p>Output 3.3.1: Gender, Indigenous Peoples presence and Water Assessment for the shared Mono basin.</p> <p>Output 3.3.2: Design of harmonized groundwater monitoring network and data loggers installed.</p> <p>Output 3.3.3: Water quality monitoring and laboratory analysis.</p> <p>Output 3.3.4: Shared data platform to support improved aquifer planning.</p> <p>Output 3.3.5: Strategic well</p>			

Project Component	Financing Type	Expected Outcomes	Expected Outputs	Trust Fund	GEF Project Financing(\$)	Confirmed Co-Financing(\$)
			<p>rehabilitation to reduce flood risk to drinking water supplies</p> <p>Output 3.4.1: Knowledge exchange, study tours & communities of practice to support cross-pilot learning.</p> <p>Output 3.4.2: Synthesis & dissemination of lessons.</p>			

Project Component	Financing Type	Expected Outcomes	Expected Outputs	Trust Fund	GEF Project Financing(\$)	Confirmed Co-Financing(\$)
Component 4 Long-term vision and capacity: Facilitating a pan-continental gender-inclusive Youth Forum in Africa around G4DR: engaging youth in G4DR dialogues, mobilizing and building the capacity of youth to develop regionally and locally relevant communication and outreach strategies and interventions , including through digital innovations; supporting pan-continental networks to enable uptake of long-term workable and sustainable strategies and solutions.	Technical Assistance	Outcome 4.1: Youth across Africa is capacitated on groundwater to enhance consideration of social and cross-sectoral dimensions of groundwater.	Output 4.1.1: Youth Forum for G4DR ? creating opportunities for youth of all genders and social differences i) for learning and interaction with professionals and decision makers active in groundwater; and ii) putting forward their voice in decision making processes. Output 4.1.2: Website or social media platform by the Youth Forum, attracting youth to the debate and building knowledge sharing around the importance of youth in taking an active role in G4DR in Africa, and continue driving the agenda forward.	GET	292,500.00	1,186,544.00

Project Component	Financing Type	Expected Outcomes	Expected Outputs	Trust Fund	GEF Project Financing(\$)	Confirmed Co-Financing(\$)
Component 5: Knowledge management and M&E: Supporting capture, exchange and dissemination of key project advancements, as well as evaluation of project progress relative to targets.	Technical Assistance	<p>Outcome 5.1 Knowledge management & dissemination to support visibility and adoption.</p> <p>Outcome 5.2 Adaptive results-based management and sharing of information and lessons learned.</p>	<p>Output 5.1.1 Programme findings and lessons learned identified and contribute to IW:LEARN.</p> <p>Output 5.1.2 Information sharing mechanism & communication strategy developed, enabling broad access to best practices and lessons learned in the countries supporting AMCOW.</p> <p>Output 5.2.1 Gender-responsive monitoring system operating and providing systematic and regular information updates on progress towards reaching G4DR targets.</p>	GET	489,664.00	1,585,514.00
Sub Total (\$)					5,510,558.00	43,207,497.00
Project Management Cost (PMC)						
GET		275,515.00			2,275,849.00	

Project Management Cost (PMC)

Sub Total(\$)	275,515.00	2,275,849.00
Total Project Cost(\$)	5,786,073.00	45,483,346.00

Please provide justification

C. Sources of Co-financing for the Project by name and by type

Sources of Co-financing	Name of Co-financier	Type of Co-financing	Investment Mobilized	Amount(\$)
GEF Agency	Food and Agriculture Organization of the United Nations (FAO)	In-kind	Recurrent expenditures	12,000,000.00
Other	International Water Management Institute (IWMI)	In-kind	Recurrent expenditures	8,400,000.00
Other	International Institute for Applied Systems Analysis (IIASA)	In-kind	Recurrent expenditures	3,500,000.00
Other	African Ministers' Council on Water (AMCOW)	In-kind	Recurrent expenditures	600,000.00
Other	Southern African Development Community (SADC)	In-kind	Recurrent expenditures	100,000.00
Recipient Country Government	Malawi Ministry of Water and Sanitation	In-kind	Recurrent expenditures	199,544.00
Recipient Country Government	Malawi Ministry of Water and Sanitation-(MWASIP) Project	Grant	Investment mobilized	6,000,000.00
Civil Society Organization	Evidence Action Malawi	In-kind	Recurrent expenditures	4,958,767.00
Recipient Country Government	Mozambique Zambezia Provincial Executive Council	In-kind	Recurrent expenditures	5,095,625.00
Recipient Country Government	Uganda	In-kind	Recurrent expenditures	1,600,000.00
Recipient Country Government	Benin	Equity	Investment mobilized	500,000.00

Sources of Co-financing	Name of Co-financier	Type of Co-financing	Investment Mobilized	Amount(\$)
Recipient Country Government	Togo Ministry of Environment and Forestry Resources	Equity	Investment mobilized	711,134.00
Recipient Country Government	Togo Ministry of Water and Hydraulics	Public Investment	Investment mobilized	1,206,278.00
Recipient Country Government	Togo Ministry of Environment and Forestry Resources	Public Investment	Investment mobilized	172,484.00
Recipient Country Government	Benin	Public Investment	Investment mobilized	150,000.00
Other	Mono River Basin Authority	In-kind	Recurrent expenditures	189,514.00
Other	British Geological Survey	In-kind	Recurrent expenditures	100,000.00
Total Co-Financing(\$)				45,483,346.00

Describe how any "Investment Mobilized" was identified

MALAWI MWASIP The 6M grant committed as co-financing is part of the grant provided by the World Bank Board of Executive Directors approved on June 19, 2020 for the Malawi Watershed Services Improvement Project (MWASIP), composed of a \$78.5 million credit and \$78.5 million grant from the International Development Association (IDA). BENIN USD 500,000 as equity investment mobilized as part of the WACA project's activities on income generating activities and the implementation of biodiversity community-based conservation management plans. USD 150,000 as public investment as part of the WACA project to build the headquarter of the associations of the ACCBs contribution to the management of surface and groundwater resources in the country. TOGO Ministry of Environment and Forestry USD 711,134 as equity investment mobilized as part of the WACA project's activities on applying evidence-based planning to realize on the ground impact pilots on groundwater resources. USD 172,484 as public investment mobilized as part of the WACA project's activities on identifying areas in Togo that present groundwater-related risks and opportunities for enhancing waster security and resilience. TOGO Ministry of Hydraulic USD 1,206,278 in public investment to support: 1) Drinking water supply and sanitation projects for 4 urban areas; 2) construction of 300 waterworks in the Plateaux region; and 3) supporting with funding mobilized the IWRM in the Mono River Basin.

D. Trust Fund Resources Requested by Agency(ies), Country(ies), Focal Area and the Programming of Funds

Agency	Trust Fund	Country	Focal Area	Programming of Funds	Amount(\$)	Fee(\$)	Total(\$)
FAO	GE T	Regional	International Waters	International Waters	5,786,073	549,677	6,335,750.00
Total Grant Resources(\$)					5,786,073.00	549,677.00	6,335,750.00

E. Non Grant Instrument

NON-GRANT INSTRUMENT at CEO Endorsement

Includes Non grant instruments? **No**

Includes reflow to GEF? **No**

F. Project Preparation Grant (PPG)
PPG Required **true**

PPG Amount (\$)
150,000

PPG Agency Fee (\$)
14,250

Agenc y	Tru st Fun d	Countr y	Focal Area	Programmi ng of Funds	Amount(\$)	Fee(\$)	Total(\$)
FAO	GET	Regiona l	Internation al Waters	International Waters	150,000	14,250	164,250.0 0
Total Project Costs(\$)					150,000.0 0	14,250.0 0	164,250.0 0

Core Indicators

Indicator 4 Area of landscapes under improved practices (hectares; excluding protected areas)

Ha (Expected at PIF)	Ha (Expected at CEO Endorsement)	Ha (Achieved at MTR)	Ha (Achieved at TE)
0.00	26000.00	0.00	0.00

Indicator 4.1 Area of landscapes under improved management to benefit biodiversity (hectares, qualitative assessment, non-certified)

Ha (Expected at PIF)	Ha (Expected at CEO Endorsement)	Ha (Achieved at MTR)	Ha (Achieved at TE)
	26,000.00		

Indicator 4.2 Area of landscapes under third-party certification incorporating biodiversity considerations

Ha (Expected at PIF)	Ha (Expected at CEO Endorsement)	Ha (Achieved at MTR)	Ha (Achieved at TE)
Type/Name of Third Party Certification			

Indicator 4.3 Area of landscapes under sustainable land management in production systems

Ha (Expected at PIF)	Ha (Expected at CEO Endorsement)	Ha (Achieved at MTR)	Ha (Achieved at TE)
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Indicator 4.4 Area of High Conservation Value or other forest loss avoided

Disaggregation Type	Ha (Expected at PIF)	Ha (Expected at CEO Endorsement)	Ha (Achieved at MTR)	Ha (Achieved at TE)
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Indicator 4.5 Terrestrial OECMs supported

Name of the OECMs	WDPA-ID	Total Ha (Expected at PIF)	Total Ha (Expected at CEO Endorsement)	Total Ha (Achieved at MTR)	Total Ha (Achieved at TE)
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Documents (Please upload document(s) that justifies the HCVF)

Title Submitted

Indicator 7 Shared water ecosystems under new or improved cooperative management

	Number (Expected at PIF)	Number (Expected at CEO Endorsement)	Number (Achieved at MTR)	Number (Achieved at TE)
Shared water Ecosystem	Global	Shire Valley Alluvial Aquifer, Mono, Global		
Count	1	3	0	0

Indicator 7.1 Level of Transboundary Diagnostic Analysis and Strategic Action Program (TDA/SAP) formulation and implementation (scale of 1 to 4; see Guidance)

Shared Water Ecosystem	Rating (Expected at PIF)	Rating (Expected at CEO Endorsement)	Rating (Achieved at MTR)	Rating (Achieved at TE)
Shire Valley Alluvial Aquifer		4		
Mono		1		
Global	1	1		

Indicator 7.2 Level of Regional Legal Agreements and Regional management institution(s) (RMI) to support its implementation (scale of 1 to 4; see Guidance)

Shared Water Ecosystem	Rating (Expected at PIF)	Rating (Expected at CEO Endorsement)	Rating (Achieved at MTR)	Rating (Achieved at TE)
Shire Valley Alluvial Aquifer		2		
Mono		1		
Global	1	1		

Indicator 7.3 Level of National/Local reforms and active participation of Inter-Ministeral Committees (IMC; scale 1 to 4; See Guidance)

Shared Water Ecosystem	Rating (Expected at PIF)	Rating (Expected at CEO Endorsement)	Rating (Achieved at MTR)	Rating (Achieved at TE)
Shire Valley Alluvial Aquifer		2		
Mono		2		
Global	1	1		

Indicator 7.4 Level of engagement in IWLEARN through participation and delivery of key products(scale 1 to 4; see Guidance)

Shared Water Ecosystem	Rating (Expected at PIF)	Rating (Expected at CEO Endorsement)	Rating (Achieved at MTR)	Rating (Achieved at TE)
Shire Valley Alluvial Aquifer		1		
Mono		1		
Global	1	1		

Indicator 11 People benefiting from GEF-financed investments

	Number (Expected at PIF)	Number (Expected at CEO Endorsement)	Number (Achieved at MTR)	Number (Achieved at TE)
Female	500	13,680		
Male	700	20,520		
Total	1200	34200	0	0

Provide additional explanation on targets, other methodologies used, and other focal area specifics (i.e., Aichi targets in BD) including justification where core indicator targets are not provided

Re to Indicator 4: The groundwater monitoring network will be designed for the whole catchment area (the optimal location of monitoring boreholes will be determined). After the optimal monitoring network is designed, a phased approach will be followed, where monitoring boreholes are drilled and equipped in phases depending on fund availability. The density of wells in a groundwater monitoring network depends on several factors, which include the cost of drilling, aquifer geology and groundwater flow, regulatory requirements, and the type of monitoring network. Assuming a monitoring network density of 1 in 10 km² (Jousma, 2008), the area under improved management is estimated. The area under improvement management for the Shire with 14 boreholes equipped with a data logger is 14,000ha, which is 3.5% of the area of the transboundary Shire alluvial aquifer. In application of a similar process in Uganda, 2,000ha of land will be under improved management. A similar approach was adopted for the Mono assessing a total of 10,000ha of area under improved management. The Total is therefore 26,000ha. Re to Indicator 7: The project is focused on transboundary aquifers, which include the Shire River basin aquifer, the aquifer system in Uganda, and the aquifers in the Mono River basin. Both the Mono and Shire have been indicated. A TDA has already been developed for the Shire system therefore sub-indicator 7.1 was set to 4 for this system. In addition, we kept global in this CI to encompass the Pan-African nature of the project. We set all sub-indicators for global to 1. Re to Indicator 11: Building on Indicator 4, With a population density of 139 people/km²

based on the global world population data of 2020, this results in a beneficiary of around 20,000 people. Similarly, for the Mono River Basin, with ten monitoring boreholes equipped with data loggers, the area under improvement will be 100 km², and with the population density of 108 people/km² for the Mono River Basin, around 11,000 people will benefit. This includes as required only direct beneficiaries through work on the ground. The scaling-up will increase this number substantially within the five target countries and at the Pan-African level. In Uganda, 3,200 people will directly benefit from improved management, including approximately 420 that will be trained. The total is 34,200 people with 13,680 women, and 20,520 men.

Part II. Project Justification

1a. Project Description

PART II: PROJECT JUSTIFICATION

1.a Project Description

1. The global environmental and/or adaptation problems, root causes and barriers that need to be addressed

1.1 Contextualizing groundwater resources availability and use in Africa

Africa is home to some of the largest aquifers in the world and groundwater represents the largest freshwater resource in the continent. Aquifers are distributed across the entire continent, with some of the biggest located in the Sahara Desert region although many spread across the sub-Saharan Africa, such as the Congo Basin in Central Africa, the Kalahari Basin in Southern Africa, and the coastal aquifers in West Africa (Figure 1). The largest groundwater storage in the continent is spread across the Saharan region, while in sub-Saharan Africa storage is on average lower but recharge rates are higher (MacDonald et al., 2012). The total volume of groundwater in storage in Africa is about 0.66 million km³, although only 0.21% is considered renewable resources (1,400 km³/year). This renewable groundwater storage represents on average 13% of the world's renewable groundwater storage (AQUASTAT, 2020).

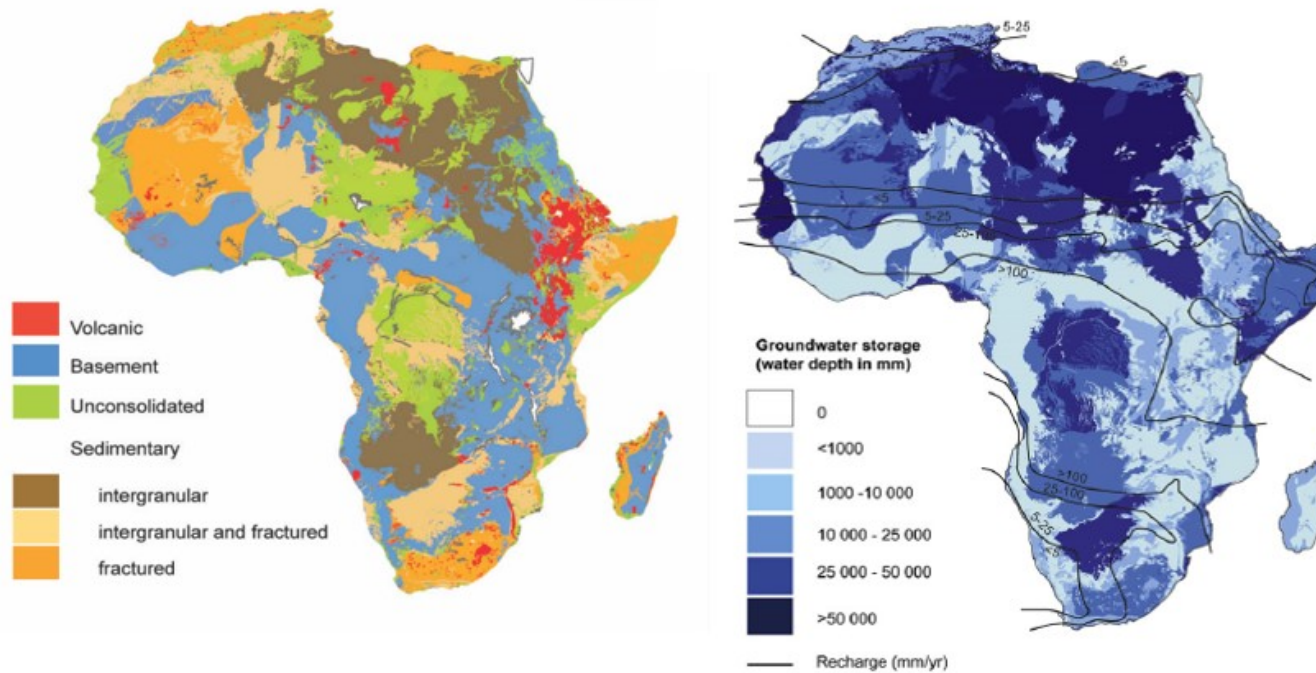


Figure 1. Distribution of aquifers based on their main hydrogeological characteristics (left) and groundwater storage potential (right). Sources: BGS (2011) and MacDonald et al (2012).

More than 100 transboundary aquifers (TBA) have been identified in Africa. TBAs underlie 40% of the continent, where 33% of the population lives, and many are located in arid or semi-arid regions (Nijsten et al, 2018). Despite their importance and representativeness, there is yet limited and fragmented knowledge on TBAs, which prevents the establishment of cooperation and management mechanism across the continent. Indeed, few TBA-specific agreements exist in Africa (Conti, 2017, ORASECOM, 2017), and integrated monitoring systems or monitoring archives with historic time series are scarce (Nijsten et al, 2018; Ebrahim & Lautze, 2021).

Groundwater abstractions represent a tiny share of the renewable groundwater storage in Africa. Out of the renewable storage annually available (1,400 km³/year), only 33 km³/year are abstracted overall. There are, however, large regional disparities across regions in terms of abstractions (Table 1). Whereas in the northern regions, abstractions are largely exceeding the renewable groundwater stock, in the rest of the sub-Saharan Africa the usage of groundwater represents a tiny share of the renewable groundwater resources. Moreover, a significant share of the groundwater used in sub-Saharan Africa is from shallow local aquifers that often have a limited geographical extent and capacity (The World Bank, 2018). These small aquifers, often linked to alluvial deposits or found in hard-rock areas, are more vulnerable to extended periods of drought. Deeper aquifers are less sensitive to annual fluctuations in rainfall but are less utilized because they are more expensive to exploit and require complex drilling and pumping technologies.

Table 1. Renewable annual groundwater recharge and abstractions, year (2019). Source: AQUASTAT (2019).

African regions	Groundwater		% abstraction/ renewable
	Renewable resources (km ³ /year)	Groundwater abstractions (km ³ /year)	
Central	841	<1	< 0.1
Eastern	108	1	0.7
Northern	14	25	179.1
Southern	139	5	3.3
Western	317	3	0.9
Total Africa	1419	33	2.4

Tapping the potential of groundwater resources must consider both physical availability and economic viability. Despite their abundance, much of the continent's groundwater stock is stored in deep aquifers, which require more complex drilling and pumping technology to enable water abstraction. More complex drilling and pumping technology, in turn, typically brings higher costs. Investments in resource confirmation and characterization, to enable optimal drilling and pumping, are also high since there is limited knowledge base on groundwater. Overall upfront investments costs for groundwater use tend to be higher than for surface water in Sub-Saharan Africa (The World Bank, 2018), which have a major influence on the viability of groundwater projects since most are small scale. Nonetheless, careful planning can increase the likelihood that zones of abstraction achieve both physical availability of water and economic viability of investment.

Groundwater is largely managed (informally) by rural communities and smallholder farmers. Groundwater is very important to support livelihoods across many of the rural areas of the arid and semi-arid regions of sub-Saharan Africa where rainfall variability is high (World Bank, 2018). It is estimated that between 50-75% of the rural population in sub-Saharan Africa relies on groundwater for drinking purposes (Carter & Parker 2009, Goulden et al. 2009). Groundwater use in smallholder irrigation is yet not fully developed although there is large potential. The total cropland area in sub-Saharan Africa is about 290 million hectares (Mha), of which only 4% is irrigated (10 Mha) (AQUASTAT, 2019). Out of this, only 16% is irrigated with groundwater. Only eleven countries in sub-Saharan Africa have irrigated areas larger than 0.1 Mha, and only two (Madagascar and South Africa) have irrigated areas larger than 1 Mha.

Groundwater use in urban areas is growing. Until now, only a small number of urban water utilities in sub-Saharan Africa (for instance Abidjan, Bamako, Hargeisa, Pretoria, Dodoma, and Lusaka) use groundwater as a permanent source of supply (Foster et al., 2010). For growing cities in Africa's dryland regions, groundwater may be the only reliable and substantive future source for water supply (World Bank, 2018). Foster et al (2020) indicates that about 35% of cities in sub-Saharan Africa are located in areas with 'highly-productive aquifers', but there will also be cities where local aquifers do not have sufficient 'production potential' to support water-utility waterwells. Therefore, the options to further develop groundwater are diverse and would have to consider different development scenarios: 1) major aquifers capable of providing high waterwell yields and of supporting large abstraction; 2) intermediate aquifers allowing some urban conjunctive use or supply of specific districts; and 3) minor aquifers only supporting small waterwell yields for off-grid private supply.

Water quality issues could limit groundwater availability. Groundwater can contain both natural (geogenic) pollutants, such as arsenic or fluoride (see Figure 2), or anthropogenic pollutants, like fertilizers, pesticides or bacteriological pollution from untreated wastewater, that limit its use. In Africa, the major groundwater quality issues in order of importance can be listed as follows: 1) nitrate pollution, 2) pathogenic agents, 3) organic pollution, 4) salinization, and 5) acid mine drainage (Gaye and Tindimugaya, 2019; Xu and Usher, 2006). High nitrate levels are generally caused by poor sanitation in urban areas and fertilizer applications in rural areas. Due to a lack of monitoring, the full range of contaminants in African groundwater remains unknown.

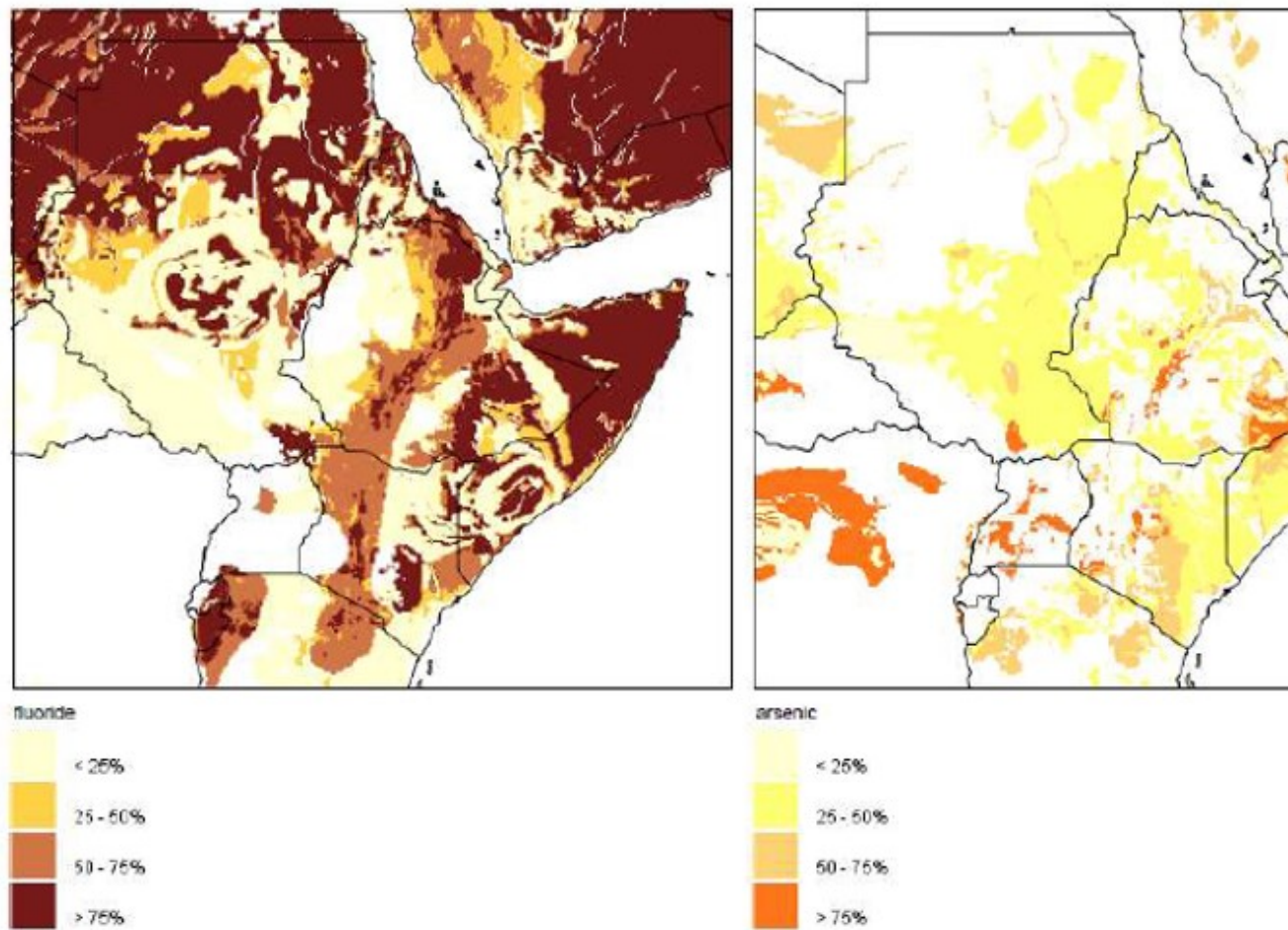


Figure 2. Modelled Fluoride and Arsenic groundwater pollution. The colours show the probability of fluoride concentrations in groundwater exceeding the WHO guideline of 1.5 mg/L and of arsenic in groundwater exceeding the WHO guideline of 10?g/L. Source: EAWAG Aquatic Research Groundwater Assessment Platform Maps

1.2 Ongoing and future climate and socio-economic trends with impacts on groundwater in Africa

Africa faces considerable water insecurity. Out of 1.3 billion people living in Africa (year 2020), 32% (418 million people) still lack a basic level of drinking water service, 60% (779 million people) lack basic sanitation services, and 65% (839 million people) lack access to basic hygiene services (JMP, 2020). Significant inequalities persist within countries including between urban and rural, between sub-national regions, and between the richest and the poorest. In urban areas, 2 out of 5 people lack safely managed drinking water, 2 out of 3 people lack safely managed sanitation, and half the population lacks basic hygiene services. In rural areas, 4 out of 5 people lack safely managed drinking water, 3 out of 4 people lack safely managed sanitation, and 7 out of 10 lack basic hygiene services. Likewise, only 3% of the cultivated land is irrigated (AQUASTAT, 2020), and water and climate

related events have impacted more than 17 million people over the last decade (GCA, 2022). Such physical, and foremost economic water scarcity contributes to chronic food insecurity, environmental migration and civil instability being endemic across many countries (World Bank, 2018). Vulnerable populations are most severely affected by lack of investments. For example, currently less than one in three women in Sub-Saharan Africa are covered by safely managed drinking water services (UN Women, 2023).

Climate change is likely to exacerbate water stress, water quality deterioration and vulnerability of populations to extreme events. The latest IPCC Report (Trios et al., 2021) predicts that Africa will get warmer faster than other regions, increasing the frequency of hot extremes, along with an overall decrease in mean precipitation, increasing frequency of heavy precipitation and pluvial flooding, and observed and projected increases in aridity across Africa. All of these climate phenomenon will continue reducing runoff and increasing the frequency and intensity of droughts and floods such by 2050 up to 921 million additional people in sub-Saharan Africa could be exposed to climate change-related water stress, while up to 459 million could experience reduced exposure (Dickerson et al., 2021). Climate change is expected to affect groundwater aquifers in Africa, directly by reducing recharge rates resulting from reduced runoff, and indirectly through increased demands, especially from irrigation (World Bank, 2016). Higher temperatures will also increase the groundwater salinity as more water evaporates before it can reach deeper levels. Rising sea levels will push seawater inland, and coastal aquifers shrink as rising demand drops groundwater tables (World Bank, 2016).

High interdependencies across sectors (e.g., water-food nexus) will amplify the risks and impacts of climate change. Higher temperatures, increasing water stress and frequency of extreme events like droughts, are and will continue to have compounding impacts on Africa's agriculture. Agricultural productivity growth has already experienced a 34% reduction since the 60s due to changing climate conditions and increasing water stress and droughts (Trios et al., 2022). Into the future, an estimated 40% of sub-Saharan countries are projected to be "at risk of significant declines in crop and pasture production" (World Bank, 2018). Without coping mechanisms, these trends pose enormous risks for the continent given the resource constraints and the high dependency on rainfed agriculture "only 6 % of the cropland area is equipped for irrigation, and less than 4% is irrigated (AQUASTAT, 2019). Surface water is the primary water source for existing irrigation schemes, and only 14% of the irrigated lands use groundwater.

Non-climatic drivers " such as population growth, urbanization and changing consumption patterns " will add significant pressures on water resources. These socio-economic drivers are known with high levels of certainty and are predicted to have a far greater influence on groundwater resources than climate stressors in the short-to-medium term. Africa's population is projected to increase by almost 79% from 1.3 billion in 2020 to 2.5 billion by 2050 (UN, 2019). This means that more than half of global population growth between now and 2050 is expected to occur in the continent. Likewise, the urban population, now roughly 600 million people (World Bank 2021), is expected to increase sharply with the number of people living in African cities almost doubling by 2050 (UN, 2019). This large increase in population numbers will inevitably lead to a substantive increase in water demand, projected to increase by almost 300% by 2050 with respect to 2005, and

mostly triggered by growing demands from irrigation and urban water supply (World Bank, 2018). Together, these trends may increase risks of conflict and migration.

Rapid urbanization will increase and concentrate the demand for water, further intensifying pressure on water resources. Africa is for some time now experiencing some of the world's highest urbanization rates, with the urban population projected to almost double by 2050 (Figure 3). Such urbanization rates will be accompanied by informal settlements and will place a very large pressure on water resources and create wastewater management challenges (World Bank, 2018). Water demands in urban areas are growing at a higher rate than population growth – as income levels of urban dwellers rise and they demand better services – while water availability is shrinking due to competing demands from agriculture, mining and industry, and from deteriorating water quality and climate change. Ultimately, African cities must do more simply to maintain the status quo in order to keep up with the demands of rapid urban population growth.

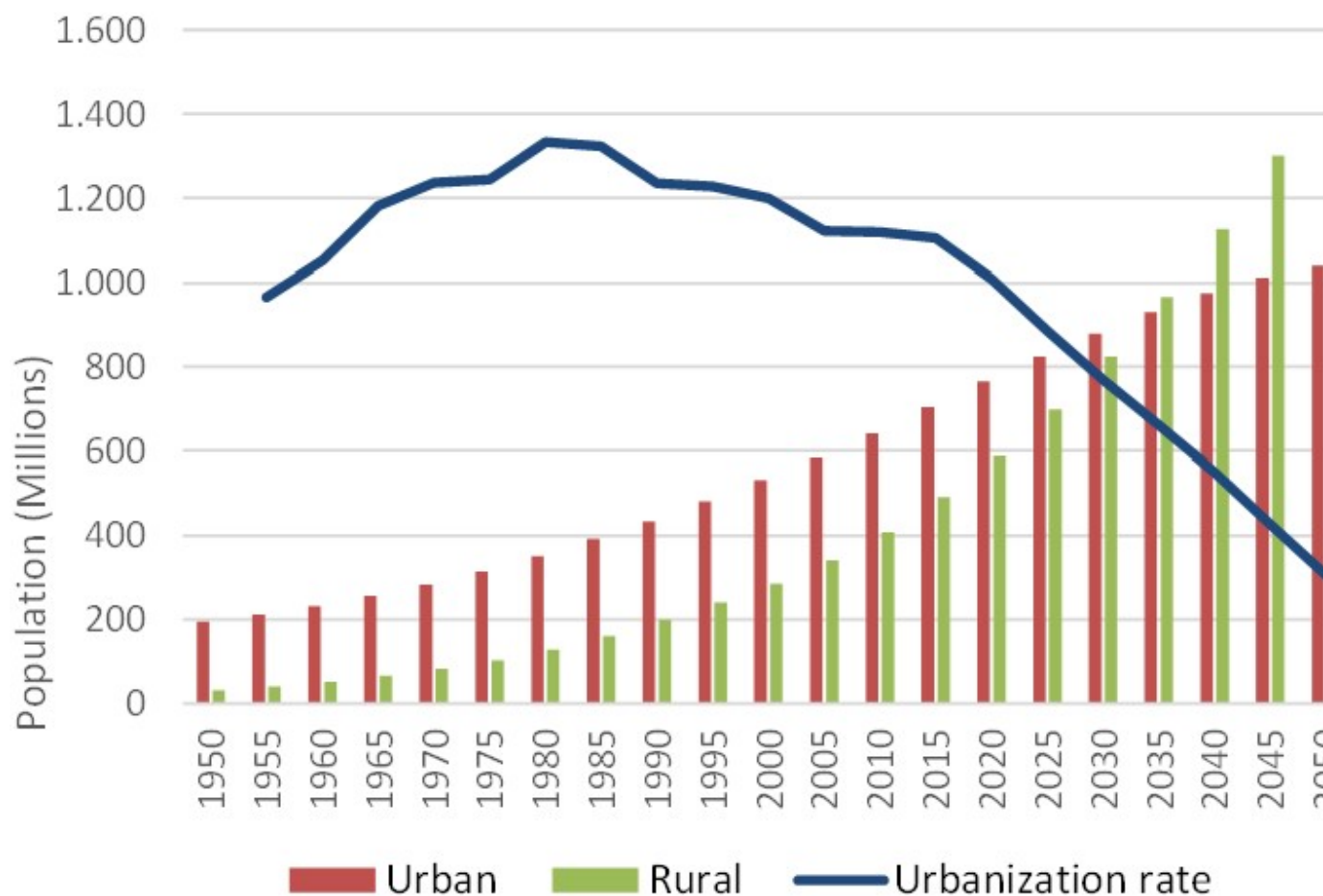


Figure 3: Population Growth in Africa. Source: UNDESA (2018)

Rural drinking water and irrigation development will remain priorities in order to satisfy rural water demands. African rural population is projected to multiply by five by 2050 (Figure 3), which will significantly increase the demand for drinking water (largely groundwater) and will require

significant efforts to bridge the WASH gap. Likewise, irrigation development is projected to increase as a result of multiple factors connected to growing food demands, impacts of climate change and in order to address the agricultural productivity gap. Currently, out of the 5% of the cultivated land that is irrigated, more than two-thirds are concentrated in northern African countries, South Africa and Madagascar. According to FAO projections, the irrigable area can be expanded by 40 million hectares in some sub-Saharan countries given that water resources are available, including groundwater. Yet, most land suited for irrigation in sub-Saharan Africa is already used by smallholders, and smallholder agriculture is in most cases better able to assure pro-poor outcomes. The development of large-scale investments in agriculture often competes with the interest of smallholders. Thus, while irrigation has large potential to be further developed, it also carries new risks, in terms of investments and conflicts. New water storage and irrigation facilities should therefore strive to specifically include smallholders in a way that carefully balances their additional risks (Scheumann et al., 2017).

1.3 Groundwater challenges, root causes and barriers that need to be addressed: knowledge gaps, limited institutional capacities and experience in groundwater management and planning

The water development agenda has been focused on surface water. Surface water development has been strongly promoted and funded by national and international investors (World Bank, 2018). As an example, most large urban water utilities rely almost exclusively on surface water sources for permanent supply (less than a handful of large urban water utilities use groundwater as a permanent source of supply). Likewise, the large majority of large-scale irrigation projects in Africa are dependent on surface waters. According to AQUASTAT (2019), 80% of the irrigated projects in Africa rely on surface waters, although these projects do not consider smallholder groundwater irrigation projects. Surface water resources are overall becoming increasingly costly to develop and are also more vulnerable to the effects of climate change. Against this background, the development of groundwater in sub-Saharan Africa has been largely informal, driven primarily by private well owners exploiting shallow aquifers for drinking water and small-scale irrigation. Most deeper aquifers remain unutilized. Given the widespread water scarcity across much of the region, this represents a potentially significant dormant economic and human development opportunity (World Bank, 2018).

Underpinning limited groundwater development is a paucity of knowledge about quantity, quality and dynamics of the resource. The development of groundwater-based knowledge, including future scenarios and projections, in Africa remains limited. Despite some positive steps taken to strengthen the evidence base (e.g., the UK-funded research program 'Unlocking the Potential of Groundwater for the Poor (UPGro)', the different research initiatives led by the German Federal Institute for Geosciences and Natural Resources (BGR) and the British Geological Survey (BGS), or the work carried out by the International Groundwater Research Assessment Center (IGRAC)) knowledge gaps regarding groundwater quality, quantity and management are ubiquitous and remain as a systematic limitation. In Transboundary Diagnostic Analyses (TDAs) performed in three shared aquifers of southern Africa (Ramotswa, Shire, Tuli Karoo), for example, data and knowledge limitations were consistently identified as key impediments to improving shared groundwater management (IWMI, 2016, 2019, 2020). Several studies (MacDonald et al. 2012; 2021) indicate that improving the quantitative, spatially-explicit information on groundwater is a pre-requisite that should

underpin the development of water-related strategies to adapt to the impacts of climate change and socio-economic developments.

Un-informed development, coupled with water quality deterioration, poses threats to ecosystems.

Despite the benefits of groundwater, the resource is vulnerable to degradation. Excessive groundwater pumping often leads to overexploitation, causing groundwater depletion, which could compromise sustainable food production and economic development and have devastating effects on natural streamflow, groundwater-dependent ecosystems, land subsidence, regional climate, and sea level rise. Geogenic groundwater contaminants such as arsenic and fluoride are widely present in part of the continent (Amini et al., 2008; Ahoul? et al., 2015; Podgorski & Berg, 2020). Anthropogenic factors and sources not only amplify natural geogenic contamination, but also introduce new contaminants into groundwater such as nitrate, pathogens and pesticides (Lapworth et al., 2020; Ravenscroft and Lytton, 2022). Likewise, groundwater is central to sustainability of the larger ecosystem, and in provision of ecosystem services. Africa possesses a large diversity of groundwater-dependent ecosystems (GDEs) (Link et al., 2023), which support the livelihoods of some of the most vulnerable Sub-Saharan populations, sometimes in hidden ways, such as for pastoralists in the Sahel through the hydraulic lift of some trees (Rodella et al., 2023). These services can be compromised when groundwater is degraded. Holistic management of groundwater is thus required to improve the reliability of water supply while avoiding environmental degradation and widespread depletion or pollution.

Capacity constraints prevent countries from advancing in strategic groundwater planning and investment.

Institutional capacity constraints include limited technical expertise, inadequate funding, insufficient institutional coordination and cooperation, and weak legal and regulatory frameworks. Groundwater legislation in Africa varies across countries, as each country has its own legal framework but with few exceptions (e.g., South Africa), it is largely underdeveloped. Small steps have been taken to address these gaps e.g., UNESCO and the Swiss Agency for Cooperation and Development as part of the GGRETA project [1], have supported AMCOW in the development of methodological guidelines for the assessment and gap analysis of groundwater-relevant legislation that can be applied and used consistently in any particular country, to analyze and assess how domestic legislation is relevant to the management and governance of groundwater. Also, AMCOW as part of the APAGroP program, along with GW-Net, BGR, UNDP, Cap-Net and other partners, is organizing trainings on groundwater resources management [2] to strength technical capacities. Despite these efforts, further efforts are required to strengthen institutional capacities at different scales, within countries (local and national), but also at regional level e.g., through the exchange of good practices across countries to promote strategic assessment and investment planning for groundwater resources.

[1] <https://unesdoc.unesco.org/ark:/48223/pf0000385174>

[2] Diene, M., Danert, K., Brentf?hrer, R. Indij, D. and Tijani, M. (2023) Groundwater Resources Management Online Course 2022.

Links between research, education and policy development need to be strengthened to support the sustainable groundwater development agenda. Collaboration with academia is instrumental so that water policies and investments can be informed and guided by sound and reliable data and

scientific knowledge. Prospective assessment of groundwater risks and opportunities should be also used to updating water policies in response to the changing climatic, socio-economic and technological conditions. Existing institutions, such as the SADC-GMI, can help facilitate this and provide a template for South-South knowledge exchange and collaboration. Likewise, other relevant initiatives include the African Higher Education Center of Excellence (ACEs) , which is a project funded by the World Bank intended to support the development of capacities of higher education institutions around STEM and other areas, also including groundwater. Currently, there are two ACEs that have placed efforts to raise the profile of groundwater development as a career path. Those are Institut International D'ingénierie De L'eau Et De L'environnement (in Burkina Faso) and Dakar American University of Science & Technology (in Senegal), but such initiatives need to be further promoted.

Groundwater management practices such as integrated aquifer monitoring, Managed Aquifer Recharge (MAR), and solar-powered pumping are rarely applied. A growing body of research suggests that a lack of consideration for groundwater in planning and management results in lost opportunity and unharnessed benefits (Scanlon et al., 2023). As groundwater remains somewhat peripheral to development planning across large parts of Africa, practical experience in roll out of solutions remains sparse. For instance, MAR solutions which comprise the purposeful recharge of groundwater into the "natural infrastructure" of aquifers to enhance groundwater storage, is expanding globally as a tool to strengthen water security (Dillon et al., 2019) by mitigating seasonal variations in water availability, controlling floods, protecting ecosystems and reducing land degradation. In Africa, however, only 52 cases of MAR have been identified, concentrated in only eight of the continent's countries (Morocco, Tunisia, Egypt, Algeria, South Africa, Ethiopia, Sudan, and Kenya) (Ebrahim et al., 2020). This comes despite the fact that 46% of the continent's area is suitable or highly suitable for MAR application (Ebrahim et al., in submission). Moreover, solar-powered pumping could enable wider access to groundwater for irrigation and water supply in Sub-Saharan Africa, given the high level of solar resources in the region and the rapidly declining solar technology costs (Rodella et al., 2023).

1.4 Summary of barriers

The project will address the following barriers which, without GEF intervention, would prevent many of the above challenges affecting groundwater planning and management in Africa from being addressed effectively.

Barrier 1: Governance and capacity for groundwater management are underdeveloped.

Currently, there is limited development and consideration of groundwater into existing governance and regulatory frameworks, limited cooperation on transboundary groundwater management, and overall, a shortage of technical capacities within existing institutions and significant knowledge gaps. Improved groundwater governance and capacity requires addressing specific barriers related to the insufficiently developed enabling environment (i.e., regulations and policies) and limited institutional capacities for planning and management. These barriers together with the limited investments, are hindering the development of a sustainable groundwater agenda across Africa. Related, in many African countries (e.g. Uganda, Kenya, Tanzania, South Africa) groundwater rights are tied to land ownership, which can create several pitfalls. It may result in mismanagement and overexploitation of groundwater, inefficient water uses practices, lack of flexibility in water allocation, inequitable distribution of resources, and

adverse environmental impacts. These aspects need to be addressed to support the formulation of policies aiming at ensuring sustainable and equitable management of groundwater resources. Likewise, there is a shortage of technical capacities within existing institutions and significant knowledge gaps in managing groundwater. The root causes are related to the limited awareness and knowledge of groundwater and the opportunities it offers to support the sustainable development agenda in Africa and increase the resilience of its economy against the growing risks of climate change. The surface water agenda has received much more attention in policy development and management as opposed to groundwater. Strengthening governance across the continent requires a multi-scale approach, working with regional, national, and transboundary institutions. At the regional level, AMCOW mandate is to support RECs, RBOs, and Member States to achieve water security and resilience with improved and more inclusive groundwater planning and management but it requires institutional and financial support.

Barrier 2: Limited data and tools to monitor and support resilient and sustainable groundwater planning and management. Despite the efforts placed by past programs supported by key actors such as BGS, BGR and IGRAC, and other relevant technical and scientific efforts, there is yet limited evidence base to inform groundwater planning and management. Improved understanding of groundwater quantity and quality issues remains patchy and will benefit from investing in information technologies to expand and update water data and increase the application of modeling results and remote sensing products at national and local levels, to help characterize and monitor groundwater resources and their key parameters. Such information is also required to do prospective assessment of future risks and opportunities to develop the groundwater agenda and support strategic planning of water-related sectoral agendas. Limited investments in expanding, maintaining and upgrading the yet limited groundwater monitoring systems (i.e., quality and quantity) limit the ability to have sufficient and up-to-date knowledge for effective planning and management of groundwater, and facilitate its economic exploitation.

Barrier 3: Limited experience and demonstration in groundwater planning. There is limited experience and exchange on practical solutions supporting groundwater-based planning. Experiences and processes set in place to support transboundary aquifer monitoring, which aims to jointly monitor a shared aquifer in order to generate a holistic and shared understanding of a system, are rarely applied (Ebrahim and Lautze, 2021). Inclusion of groundwater into national and basin planning is also rare, with few experiences available and lessons learned (e.g., lessons learned from the development of IWRM plans of Kenya, which contain provisions for the management of surface and groundwater). Experiences in supporting the conjunctive management of surface and groundwater like those of Egypt, Ethiopia, South Africa or Kenya, also need to be widely shared to identify valuable lessons learned.

Barrier 4: Limited involvement of young professionals in groundwater management. The limited awareness and recognition on the importance of groundwater has also led to a lack of involvement of youth in groundwater management despite the inter-generational relevance of groundwater resources for effectively adapting to climate change. In addition, the ability of youth to connect and establish networks and relationships to share experiences and needs are currently limited often to local context only. Related, gender and social inclusion issues are relevant to the management of groundwater resources because women and girls are commonly responsible for domestic water collection and use,

while men often dominate the administrative, political and economic institutions that determine the management of that water (Hawkins et al, 2019). Lastly, many of the constraints women face in taking part in decision making and leadership around water resources, including groundwater resources reflect the norms and traditions that shape the social structures of the communities within which they are situated. Thus, any effort that seeks to bring women and youth into the governance process of groundwater management cannot rely on quotas (percentages of men, women, or youth taking part), but rather needs to be transformative in nature.

Barrier 5: Limited compilation, synthesis and evaluation on the effectiveness of groundwater-based solutions in planning processes. Groundwater solutions can be overlooked and may go unnoticed even when they are applied. As a result, it is necessary to implement a monitoring and evaluation system that captures groundwater-based solutions when they are implemented, as well as when groundwater is introduced into planning.

2. Baseline scenario and associated projects

2.1 African-wide baseline scenario

Coordination in groundwater management to strengthen planning remains a work-in-progress. Management of groundwater resources in Africa has been described as fragmented, with limited data and information available to support decision-making (Pavelic et al 2012), although progress has been made recently. The International Groundwater Research Assessment Center (IGRAC) has been working in various parts of Africa to strengthen institutional capacities to improve groundwater use, management, and governance. Their efforts include providing technical assistance (e.g., transboundary aquifer mapping), conducting research, and facilitating knowledge sharing and capacity building activities. The Swiss Development Corporation (SDC) has supported UNESCO to advance transboundary aquifer management globally, but with key focus in selected transboundary aquifers in Africa. The World Bank has supported the Regional Economic Communities (RECs) to advance groundwater management through the creation of regional centers of excellence. Likewise, the Federal Institute for Geosciences and Natural Resources from Germany (BGR) has a large Africa-wide groundwater program under development. Past or ongoing efforts such as the 'Pan-African Groundwater Program (APAGroP)' led by AMCOW or the research program on 'Unlocking the Potential of Groundwater for the Poor (UPGRO)' coordinated by the UK Department for International Development (DFID) reflect key efforts to begin to promote a greater consideration of groundwater in water policies, support knowledge sharing and best practices across countries, strength institutional capacities to improve groundwater use, management and governance, and coordinate across such initiatives. Last, there is a relatively recent update of a groundwater map for Africa (WHYMAP) from 2018 and the Africa groundwater atlas.

Groundwater is peripheral in climate initiatives. While groundwater is the most important water source in the continent, and it plays a key role as a drought-coping resource, climate resilience strategies too often fail to internalize the central role that groundwater should play. Climate change adaptation (CCA) and disaster risk reduction (DRR) strategies and plans have been developed at pan-African, regional, and national levels (Continental Africa Water Investment Programme (AIP)

<https://aipwater.org/>); AU, 2017; UNEP, 2013; AMCOW, 2012a, b). And equally, the Climate Change and Desertification Unit (CCDU) of the AU, the Committee of African Heads of State and Government on Climate Change (CAHOSCC), the African Ministerial Conference on the Environment (AMCEN) and the ClimDEV Africa initiative (<https://www.afdb.org/en/news-keywords/climate-development-africa-climdev-africa-.initiative>) have all spearheaded efforts on climate resilience in Africa. While valuable efforts, there remains considerable opportunity to elevate the role of groundwater in realizing resilience.

AMCOW has positioned itself to coordinate groundwater activities. The African Ministers' Council on Water (AMCOW), the apex body for water management at the African level, has strengthened its capacity to support Member States in addressing groundwater as a viable and critical resource to enhance resilience and a socioeconomic transformation in Africa (AMCOW, 2021), and has through the nascent Pan-African Groundwater Program (AIP; AMCOW, 2012) laid the foundation for a concerted effort on groundwater for resilience in Africa. The African Ministers' Council on Water (AMCOW) and the African Union (AU) have called for Member States to prioritize action on groundwater development and governance for securing resilience and socioeconomic transformation in Africa. As outlined in the AMCOW White Paper (2021), there is a need to:

- Recognize the critical role of groundwater in supporting resilience and socioeconomic transformation in pursuit of Agenda 2063, which is a strategic framework for the socio-economic transformation of Africa adopted by the African Union (AU) in 2013. It is a long-term development plan that aims to guide Africa's development over a 50-year period, from 2013 to 2063.
- Take action to increase investments that build capacity and strengthen the enabling environment to realize the full potential of groundwater in line with national development priorities.
- Enhance national and regional cooperation around groundwater and transboundary aquifers within a broader goal of international water cooperation and regional integration for peace and political stability.
- Engage with APAGroP as a key mechanism for supporting Member States toward equitable and sustainable use of groundwater for achieving multiple development goals, recognizing the need for diverse context-specific pathways.

Pan-African efforts can build on regional groundwater initiatives. There is a growing body of regionally-driven initiatives on groundwater in Africa. SADC groundwater work, including SADC-Groundwater Management Institute (SADC-GMI), hosts an annual knowledge exchange event and engages with RBOs. Key work has been undertaken between SADC-GMI and IWMI on incorporating groundwater into transboundary basin management. Similarly, OSS is an important centre of expertise in West Africa and IGAD is emerging in its role on groundwater management in the Horn of Africa. Furthermore, GEF support to countries and RBOs by BGR, UNESCO and its GRETA program, IGRAC, SDC is also important. Finally, there is an important role for the African Network of Basin Organizations (ANBO) to play in mobilizing RBO networks to foster input, feedback and dissemination of key areas of groundwater activity, ensuring groundwater activities plug into broader planning and discussion.

Pan-African efforts can link with projects in particular basins, aquifers and countries implemented by the project consortium. Recognizing the dispersed but growing number of activities in particular countries or on specific aquifers with adaptation elements, particularly among the consortium of partners involved in implementing the proposed project, it is essential to foster linkage and synergy. As noted below in this ProDoc, GEF projects with a geographic focus on Africa include the GEF Conjunctive Water Management project for the Nile Basin Initiative (bit.ly/3okfhy2) and other transboundary projects with an emphasis on aquifers, e.g. the GEF project under the Nile Basin Initiative focusing on the Kagera aquifer shared by Burundi, Rwanda, Tanzania and Uganda, the Mt. Elgon aquifer shared by Kenya and Uganda, and Gedaref-Adigrat aquifer shared by Ethiopia and Sudan (bit.ly/3Df3Njv). In addition, IWMI has been engaged in multiple transboundary aquifers in southern Africa, such as the Ramotswa, Shire, and Tuli Karoo (<https://conjunctivecooperation.iwmi.org/>). Finally, IIASA has been active in Lake Victoria basin and Uganda by implementing projects to assess the impact of climatic and socio-economic changes on water quantity and quality.

Table 2. Baseline projects at a pan-Africa or regional-level.

Project/Program	Lead Executing Institutions	Investment & period	Geographical focus (cities, country, regional)	Objective
ONGOING				
Global Groundwater Information System (GGIS).	International Groundwater Research Assessment Center (IGRAC)	2004-ongoing	Global, Africa, country	interactive portal for sharing data and information on groundwater resources around the world. It gives access to map layers, documents, and well and monitoring data. It also contains several thematic map viewers. Among the different resources, it contains a MAR database for Africa
<u>World-wide Hydrogeological Mapping and Assessment Programme (WHYMAP)</u>	German Federal Institute for Geosciences and Natural Resources (BGR) and UNESCO	Ongoing	Africa, national, basin, transboundary	An initiative that makes world-wide hydrogeological maps freely available. Geoportal containing maps on different themes related to groundwater in Africa and beyond

Global Gravity-based Groundwater Product	International Groundwater Research Assessment Center (IGRAC)	2020-ongoing	Global, Africa, countries	Capitalize from the unique capability of GRACE and GRACE-FO satellite gravimetry as the only remote sensing technology to monitor subsurface mass variations and eventually groundwater storage change for large areas. It takes a global approach but one of the case studies is located in Lesotho.
Assessing the Impact of Climate Change and Variability on Groundwater Resources in Major Aquifers.	International Atomic Energy Agency (IAEA)	2020-ongoing	Africa	To improve the supply of groundwater resources for human consumption and industrial use.
Assessing Groundwater Vulnerability to Anthropogenic Activities and Climate Change Using Isotopic Tool	International Atomic Energy Agency (IAEA)	2020-ongoing	Africa	To develop evidence-based guidance on assessing how urban groundwater can support adaptation and build resilience to climate change.

<p>The Cooperation in International Waters in Africa (CIWA) program</p>	<p>The World Bank</p>	<p>2011-ongoing</p>	<p>Africa, regional, countries</p>	<p>The Sahel Groundwater Initiative. Focus of the project was providing solutions to remove constraints and limitations on the use of groundwater for small-scale irrigation, reviewing the status of groundwater assessment and exploration capacity in the Western Sahel, and facilitating regional cooperation around the development of groundwater expertise in the Sahel. Through their analysis and typology of groundwater-dependent ecosystems, CIWA has identified data gaps and existing barriers to gender equality, including in access to groundwater for irrigation, groundwater management activities, and careers in the hydrogeology field.</p> <p>Nile Cooperation For Climate Resilience (NCCR). Focus provides direct support to NBI NBD, and LVBC in order to collaboratively carry out components in flood- and drought- risk mitigation, dam safety capacity building, water quality investment planning and prioritization, the platform for cooperation, and innovative information services for climate-resilient investment planning</p> <p>Horn Of Africa Groundwater Initiative. strengthening regional cooperation and capacities in groundwater development and management and expanding the knowledge base on groundwater</p>
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			<p>resources. The project successfully increased knowledge about groundwater, including a determination of surface water availability, water variability, and natural recharge of shallow groundwater and assessed the feasibility of potential investments. This project has led to a follow up one called Horn of Africa Groundwater for Resilience (GW4R).</p> <p>Southern Africa Drought Resilience Initiative. generate tools and dialogue for enhancing partnerships and capacity across the region and to inform future national and regional investments in drought resilience-building activities. SADRI produced Drought Resilience Profiles that provide a snapshot of the drought situation in each country, as evaluated through SADRI's organizing approach</p>
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Global Groundwater Monitoring Network (GGMN)	International Groundwater Research Assessment Center (IGRAC)	2020-ongoing	Global, Africa, countries	Participative, web-based network of networks, set up to improve quality and accessibility of groundwater monitoring information and subsequently our knowledge on the state of groundwater resources. GGMN is a UNESCO programme, implemented by IGRAC and supported by many global and regional partners. It provides insights on the availability of groundwater monitoring data through space and time. Groundwater level data and changes occurring in groundwater levels can be displayed on a regional scale. Member states which are interested in making use of the GGMN are provided with a password protected environment within the portal. National Groundwater Monitoring Program in Africa.
Ethiopia Water and Landscape Governance (EWLG).	Stockholm International Water Institute (SIWI)	2020-ongoing	National	Technical support to support groundwater governance in Ethiopia including a series of activities such as: 1) development of the Ethiopia National Integrated Water Resources Management plan, 2) comprehensive review of Ethiopia's groundwater law and policy, 3) wide-ranging national and basin level dialogues on Integrated Water Resources Management, and 4) integrate gender and youth across the programme activities implemented.

Sustainable Water Security for Human Settlements in Developing Countries under Climate Change.	UNESCO International Hydrological Programme (UNESCO-IHP)	2017-ongoing	Gabon, Kenya, and Zambia	Focus countries for this phase: Gabon, Kenya, and Zambia. More African countries to be included. The project aims to fund engineering work to improve access to quantity and quality of groundwater.
Groundwater Solutions Initiative for Policy and Practice (GRIPP)	Water Cycle Innovation	2016-ongoing	Global	Independent open global consortium of partners set up to connect, strengthen, expand and connect groundwater-related projects and initiatives. It focuses on the groundwater-dependent, food-producing areas of the world, particularly in low income and emerging economies, where it supports water and food security. Through dynamic partnerships, GRIPP promotes and adapts tested technologies and innovative policy and institutional approaches, in order to achieve the SDGs related to climate resilience, food security, livelihoods and sustainable water management.
The Africa Higher Education Centers of Excellence (ACE) Project.	The World Bank	2014-ongoing	African countries	World Bank initiative in collaboration with governments of participating countries to support Higher Education institutions in specializing in Science, Technology, Engineering and Mathematics (STEM), Environment, Agriculture, applied Social Science / Education and Health. It is the first World Bank project aimed at the capacity building of higher education institutions in Africa.

<p>GEF IW:LEARN 5</p>	<p>UNESCO IOC</p>	<p>2023-2025</p>	<p>Global, African countries</p>	<p>Within this project there is a Component 4: Deliver Support to Surface Freshwater, Groundwater and Large Marine Ecosystem Subsets in Support of Portfolio Strategic Priorities. Two relevant activities connected to our project are organized. These will be coordinated by UNESCO IHP.</p> <p>Activity 4.2.1: Dialogues to promote conjunctive management of surface water and groundwater GEF projects</p> <p>Activity 4.2.2: Enhance the capacity of the GEF projects in groundwater governance issues</p>
<p>Governance of Groundwater Resources in Transboundary Aquifers (GGRETA)</p>	<p>UNESCO-IHP</p>	<p>2019-ongoing</p>	<p>Transboundary aquifers, river basins</p>	<p>To strengthen regional stability, cooperation and peace through the establishment of cooperative frameworks for transboundary groundwater governance in River Basin Organisations (RBOs), Regional Commissions (RCs) and selected aquifers systems in Africa, Central America and Central Asia.</p>

<p>Pan-African Groundwater Program (APAGroP)</p>	<p>African Ministers' Council on Water [AMCOW]</p>	<p>2019-</p>	<p>Africa</p>	<p>1) Increased awareness and political commitment to groundwater, with better representation of groundwater in water policies and major water-focused programs at various levels across the continent. Related projects: AMCOW Policy White Paper</p> <p>2) Continental cooperation, knowledge sharing and collective action between Member States and partners to establish a pan-African community of best practice on groundwater.</p> <p>3) Efficient linkages between the research community, practitioners and policymakers to promote evidence-based decision making on groundwater-related issues. Related projects: online training has been developed on Groundwater Management to raise awareness about groundwater policy, regulation and improvement of practices; built capacity for comprehensive knowledge on aquifers? characteristics and generate awareness on transboundary aquifer management; and provide basic understanding of groundwater processes and their interactions with urbanization, agricultural & industrial activities, and land use in the African context</p> <p>4) Strengthened institutional and individual capacity to improve groundwater use, management and governance. Related projects: Development of</p>
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				<p>a Groundwater Country Support Tool: using Namibia as a pilot study. This tool is intended to: 1) To analyse the current status and institutional set-up of groundwater development in Namibia, 2) To identify key challenges and potentials in groundwater management, and 3) To develop an action plan that proposes measures to address the identified needs of, and management, governance and investments in groundwater.</p> <p>Methodology of analysis and assessment of National Groundwater Legislation: These guidelines are intended to provide guidance to countries to systematically assess how groundwater is addressed in the national and sub-national legislation and undertake a gap analysis.</p>
<p>The Horn of Africa- Groundwater for Resilience Project (HoAGW4R)</p>	<p>World Bank, International Waters in Africa (CIWA), Intergovernmental Authority on Development (IGAD), Kenya's Ministry of Water, Sanitation & Irrigation and State Agencies including WRA, WSTF and Regional Centre for Groundwater Resources, Education, Training and Research.</p>	<p>2023-ongoing</p>	<p>Horn of Africa</p>	<p>The objective is to increase the sustainable access and management of groundwater in the Horn of Africa's (HOA) borderlands.</p> <p>The project outcome will support WB plans for large investments in the HOA region to boost economic development, food production, and human welfare and strengthen resilience to drought impacts.</p>

<p>Africa Water Investment Support Programme to Water, Climate, Development and Gender (AIP WACDEP-G)</p>	<p>Global Water Partnership (GWP), Africa Union Development Agency-NEPAD, AMCOW, Regional Economic Communities (RECs), River Basin Organisations (RBOs), IWMI, UN WOMEN</p>	<p>2022</p>	<p>Uganda, Benin, Cameroon, Zambia, Tunisia</p>	<p>The overall objective of the AIP WACDEP-G programme is to transform gender inequalities at scale by promoting gender-transformative planning, decision-making and institutional development for climate resilient water investments in Africa.</p>
<p>PAST</p>				

<p>Unlocking the Potential of Groundwater for the Poor (UPGro)</p>	<p>UK's Department for International Development (DFID), the Natural Environment Research Council (NERC), and the Economic and Social Research Council (ESRC)</p>	<p>2013-2021</p>	<p>Africa, national, basin</p>	<p>Advancing the knowledge base on where is groundwater in Africa and in which status. Related project: The Africa Groundwater Atlas and Literature Archive</p> <p>Assess management and institutional arrangements are needed to support this access in an inclusive and sustainable way to groundwater. Related projects: GroFutures; establishment of a Network of African Groundwater Observatories (NAGO) to promote collection, assimilation and use of groundwater data. The NAGO comprises 3 Basin Observatories in Ethiopia (Upper Awash), Niger and Nigeria (Iullemmeden), and Tanzania (Great Ruaha) along with 4 Site Observatories in Benin, Burkina Faso, South Africa and Uganda.</p> <p>T-GroUP: Experimenting with practical transition groundwater management strategies for the urban poor in Sub Saharan Africa</p>
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Strengthening the institutional capacity of African Network of Basin Organization (ANBO).	The African Network of Basin Organizations (ANBO)	2016-2022	Africa river basins	To strengthen the coordination and collaboration capacity of African Lake and River Basin Organizations (L/RBOs), Commissions and/or cooperative frameworks for transboundary groundwater management and their Member States towards improved transboundary water governance in Africa through the improved support by the African Network of Basin Organization (ANBO). Specific objectives: 1. Strengthening ANBO's institutional and technical capacity as a technical arm of AMCOW; and 2. Supporting the capacity building of Lake/River Basin Organizations, Groundwater Commissions and RECs to foster transboundary cooperation
Policy, Legal and Institutional (PLI) and Gender Equality and Social Inclusion	Groundwater Management Institute (SADC-GMI)	2018-2021	Southern Africa	This project seeks to develop a Gender Equality and Social Inclusion (GESI) assessment of the requirements within the groundwater sector.
GMI Policy, Legal & Institutional (PLI) Enabling Environment Roadmaps and Implementation of PLI Quick-win interventions in Selected SADC Member States and at SADC Regional Level.	Groundwater Management Institute (SADC-GMI)	2018-2019	Transboundary	Development of roadmaps to address the Policy, Legal and Institutional framework for groundwater management at the SADC regional Level and in the Limpopo River Basin Riparian States

Updating the SADC-GMI groundwater information portal (GIP)	International Groundwater Research Assessment Center (IGRAC)	2019-2020	National, southern Africa	Make the inventory of groundwater datasets and databases in the SADC region, and to develop a data and information sharing portal, the SADC Groundwater Information Portal (SADC-GIP).
Capacity Building for Groundwater Data Collection and Management in SADC Member States	International Groundwater Research Assessment Center (IGRAC)	2017-2019	National, southern Africa	Trainings in collecting and managing groundwater data among the SADC Member States. Furthermore, a Framework for groundwater data collection and management was developed
Groundwater in fast-growing cities in Western Africa	International Groundwater Research Assessment Center (IGRAC)	2020-2021	Cities, western Africa	As part of the WHYMAP program, IGRAC assessed the status of groundwater use and management for the largest city in each of the 15 member states of the Economic Community of West African States (ECOWAS).

2.2 Case Study Baseline

Selected pilots are the outcome of a vertically-integrated engagement process. A process to select case studies typically included discussion among AMCOW, FAO, IWMI and IIASA, followed by discussion with Regional Economic Communities, and then finally direct discussion with RBOs or countries. The selected pilots are: the Shire Aquifer System, the Upper Nile Management Zone of Uganda, and the Mono Basin (Figure 4). Alternatives considered but not selected included the Volta Basin, Senegal-Mauritania Aquifer Basin, and the Kavango-Zambezi (KAZA) transfrontier conservation area.

Criteria guiding pilot selection. Pilots were identified based on at least three criteria: i) demand, ii) representativeness, iii) potential for innovation. Demand is presumed to be reflected in the number and severity of groundwater challenges, as well as expressed interest from key stakeholders. Representativeness is presumed to be reflected by the degree to which hydrogeological conditions and institutional contexts in pilots are consistent with those elsewhere in Africa. Potential for innovation is considered as the degree to which the policy context is sufficiently ready for changes envisioned through the project. Application of these criteria led to selection of the three sites:

- i) Regional organizations and local stakeholders expressed strong interest in the selected sites, and flagged key challenges and opportunities the project could work to address.
- ii) Two of the sites cover transboundary aquifers, of which there are many in Africa. Lessons emerging from the transboundary case studies thus hold potential for application in many transboundary contexts in Africa. One site covers a portion of Uganda, which is consistent with conditions of aquifers contained by one country, but in a broader transboundary river basin, which is also prevalent in Africa. All sites reflect conditions in which there is potential for greater consideration of groundwater.
- iii) All sites were considered to reflect contexts in which innovative change is viable and achievable. In the Shire, there is interest to take forward transboundary progress made in through SADC-GMI-facilitated cooperation in the past. In Uganda, elaboration of catchment plans presents a key opportunity to foster the incorporation of groundwater. In the Mono, a recently formed RBO provides a key conduit for fostering consideration of groundwater at a basin-level.

Pilot synergies and linkages. Work in the Shire builds on past collaboration between SADC-GMI and IWMI, and will fit well as a positive example of conjunctive cooperation in southern Africa. Uganda will complement IGAD's program of activities, by covering portions of aquifers not captured in their Horn of Africa initiative. Finally, focus on the Mono was proposed by AMCOW and ECOWAS, and accepted by the Mono Basin Authority (MBA), and as such will be well nested in AMCOW programs. Ultimately, the three pilots will feature in AMCOW and REC frameworks and as such embody vertical integration that serves to showcase pilot progress and outcomes. Practically, this will be achieved through participation of AMCOW & REC focal points in pilot activities.

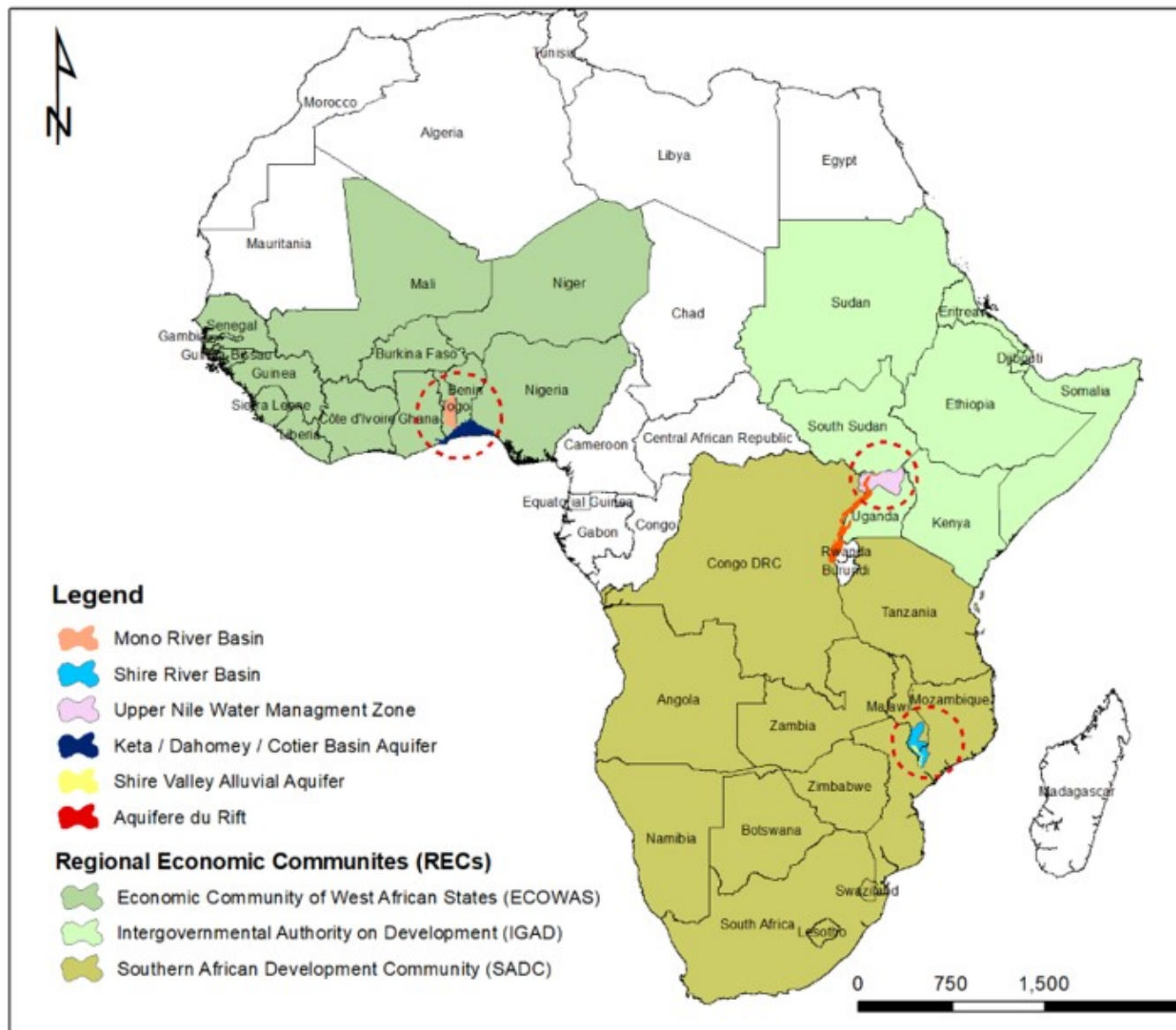


Figure 4. Pilot Case Studies.

Context in pilots. Conditions in the pilots are consistent with broader conditions in Africa. All case studies appear to possess potential for additional development of groundwater. All case studies appear to face existing and future climate risk, manifested in periodic floods and droughts. Likewise, all face water quality challenges though these manifest in different ways. In the Mono, key water quality challenges relate to urban pollution and saltwater intrusion. In Uganda, water quality issues relate to agricultural and urban pollution. And in the Shire, the primary issue is fluoride, nitrate and salinity. In addition, all three pilots face typical conditions of high population growth, agricultural development, and urbanization. Moreover, in all three pilots gender gaps persist across several social and economic dimensions, which may affect how groundwater as viable alternate water source may be perceived, and the level of equality embedded in the management and governance of the resource. There is a clear

need to coordinate groundwater management so that it can play an optimal role in each pilot's development drive, as well as be fully harnessed to cope with climate change impacts such as droughts.

Enhancing groundwater-based planning through improvements to groundwater management and governance. Given the present conditions and challenges in pilots, there is clear need to enhance planning and management of groundwater, and ensure a move towards more equal representation of men, women and youth. Enhancing groundwater planning and management can relate to improving skills and capacity in areas such as data processing, hydrogeological modelling, and monitoring. Enhancing technical capacities can also be related to targeted monitoring of key parameters such as water levels as well as key water quality parameters such as heavy metals and nutrients, in order to provide an evidence base for improving water management. Indeed, enhancing groundwater planning and management is also related to creating awareness and supporting agency with women and youth so that they can participate more fully in the governance process. Such activities need to be built into sustainable governance frameworks e.g., basin planning of existing national institutions, RBOs, or to-be-formed cross-border committees. Together, such efforts can lay a basis for formulation of strategic interventions centered on tools such as managed aquifer recharge, conjunctive management, and solar pumping.

Shire River-Aquifer System: Supporting a cooperative groundwater planning framework

The Shared Shire River-Aquifer System. The Shire River Basin (approx. 32,800 km²), shared by Malawi and Mozambique, contains at least two transboundary large aquifers. In the northern portion of the Shire River Basin, a weathered basement aquifer exists that crosses just beyond the eastern border of Malawi in a few places. The total area of this weathered basement aquifer is nearly 10,500 km² in size and approximately 96% of this area falls within Malawi. In the southern portion of the Shire River Basin, a productive alluvial aquifer exists which has its northern portions in Malawi and southern portion in Mozambique (Figure 5). This alluvial aquifer is nearly 5,500 km² in area and is divided roughly equally between the two countries.

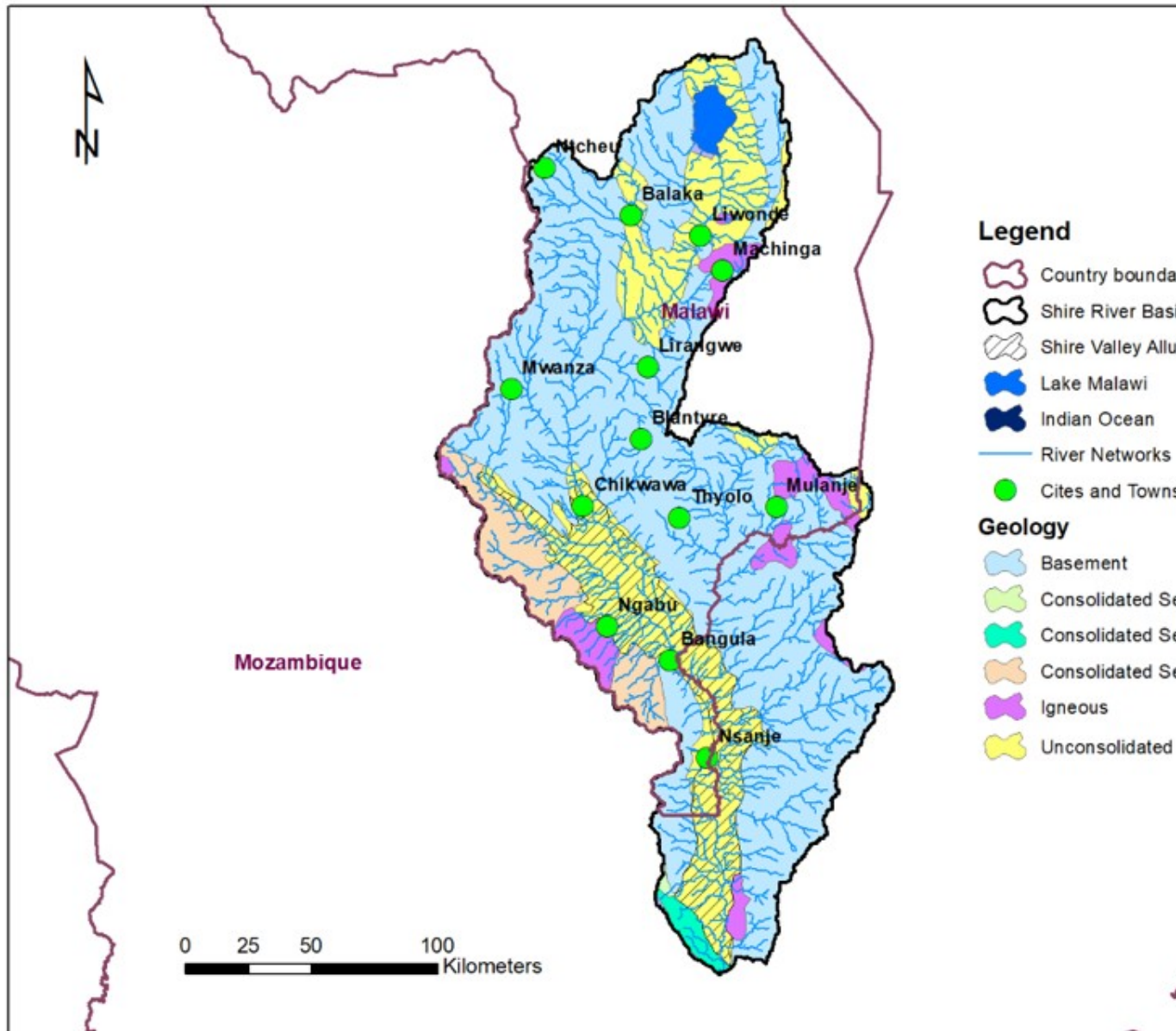


Figure 5 Shire River Basin and Shire Valley Alluvial Aquifer geology legend represent dominantly fractured flow (F), dominantly intergranular flow (I), and mixed flow (IF).

Changing climate in the Shire System may result in aquifer depletion. The frequency and intensities of floods in the Shire is increasing while adaptation measures remain limited (Mijoni and Izadkhah, 2009). Rising global temperature increases the moisture that the atmosphere can hold, resulting in storms and heavy rains, but on the contrary, more dry spells as more water evaporates from the land (Browder et al., 2021). Climate change affects groundwater by affecting recharge rate or indirectly by change in groundwater use (Taylor et al., 2013). Less groundwater recharge leads to a drop in groundwater level, impacting groundwater availability, baseflow, and water quality. Future projections may cause a decline in groundwater levels and availability due to increasing demand and declining recharge. Equally, high possibility of depletion for the Shire aquifer has been noted (Rodella et al. 2023).

Water use in the Shire is rapidly increasing. Water use is expected to increase going forward in the domestic and agricultural sectors. In the domestic sector, there is need to roll out access to the nearly half of the basin population that lacks access to an improved water source; this will drive greater water use. Agriculture, the dominant activity in the basin, remains mostly rainfed, but plans are underway to expand this area, mainly in Malawi (IWMI, 2019). The area of irrigated land in the Shire River Basin to 50, 000 ha by 2030, reflecting a nearly 40% increase from 2016 (IWMI, 2019).

Increasing water use may compromise ecosystems. Ecosystems in the basin depend on water availability from the Shire River and the Shire aquifer for their survival, and changes in groundwater availability and quality could have wide-ranging impacts on biodiversity and ecosystem services. Wetlands are known to be highly sensitive to changes in hydrological regimes, and declining groundwater levels could lead to the loss of wetland habitats and associated species. Declining groundwater levels in the Upper Shire River Wetlands have already resulted in a loss of biodiversity and ecosystem services, including reduced water availability for domestic and agricultural use. Indeed, declining water levels in the Upper Shire River Wetlands have already led to a loss of grazing resources and reduced availability of non-timber forest products.

Growing groundwater quality concerns pose risks to human use. High agricultural and industry polluted runoff into the groundwater aquifers within the basin alongside suspected pit latrine pollution and poorly treated domestic and industrial wastewater from Blantyre and other small towns in Malawi poses a threat to groundwater quality within the Shire System. The main groundwater concerns in the Shire River include high fluoride, iron, arsenic content and salinity. Fluoride concentration in the Shire River Basin in Malawi, while generally above the WHO drinking standard of 0.6-0.8 mg/l, is an area of concern (Smedley, 2004). Related, in the past several boreholes in the lower shire valley in Malawi, were abandoned due to high salinity (Smith-Carrington and Chilton, 1983).

Limited cooperative activity on groundwater. While optimal approaches that respond to Shire's challenges would build on principles of integrated basin and aquifer management, collaboration on water ? particularly groundwater ? has not been extensive. In 2018-2018, SADC-GMI and IWMI implemented a project with partners in Malawi and Mozambique focused on co-development of a TDA and identification of joint strategic actions. Priority key actions can now be taken forward such as an assessment of groundwater flow quantity across the Malawi-Mozambique border, which can be based on improved monitoring data could strengthen this assessment. Indeed, at present there are only eight monitoring boreholes in the Malawi portion of the Shire catchment (i.e., on average, one monitoring borehole for every 2840 km².) and no single observation well in the Mozambique portion, making it difficult to assess groundwater resources in a holistic manner.

Knowledge gaps constrain cooperation. A cooperative framework that outlines modalities for key areas of collaboration like data exchange, transboundary meetings, and joint investigations can lay a powerful basis achieving integrated management of the shared water system. Such a framework can play a key role, for example, in setting common water quality parameters (microbiological, physical, and chemical) and standards for pollutants such as Faecal coliforms, Total Dissolved Solids, and Iodine. Joint monitoring and planning practices between the two Member States could also assist in

identifying vulnerable areas. At present, however, data-constrained and fragmented management constrains optimal management. Although groundwater recharge within the Malawian portion of the basin is well established, for example, recharge within the Mozambique portion of the basin is not. More thorough recharge estimates and comparison of such estimates with water use can benefit both countries to assess surplus or deficits in available resources, seasonally and inter-annually. Furthermore, the Shire basin suffers from multiple sources of contaminants which pose a growing risk to public health, food security, biodiversity, and other ecosystem services. Identifying the main contaminants of concern and assessing their spatial and temporal variability at the catchment scale is a crucial step toward identifying key physical processes and factors controlling these variabilities. Which is in turn critical for better management and sound decision-making. However, there is no systematic water quality monitoring in response to potential water pollution and its transboundary implications.

Uganda: Incorporating groundwater into planning in the Upper Nile Water Management Zone (UNWMZ)

The Upper Nile Water Management Zone. In Uganda, the Ministry of Water and Environment has advised to work in the Upper Nile Water Management Zone (UNWMZ). This water management zone (approx. 50,000 km²) covers the northern part of Uganda (Figure 6), and borders with South Sudan and Kenya. The climate in the UNWMZ is generally tropical, with two wet seasons and two dry seasons. The region is susceptible to climate variability and extreme weather events, such as floods and droughts, which can have significant impacts on agriculture, water resources, and local communities.

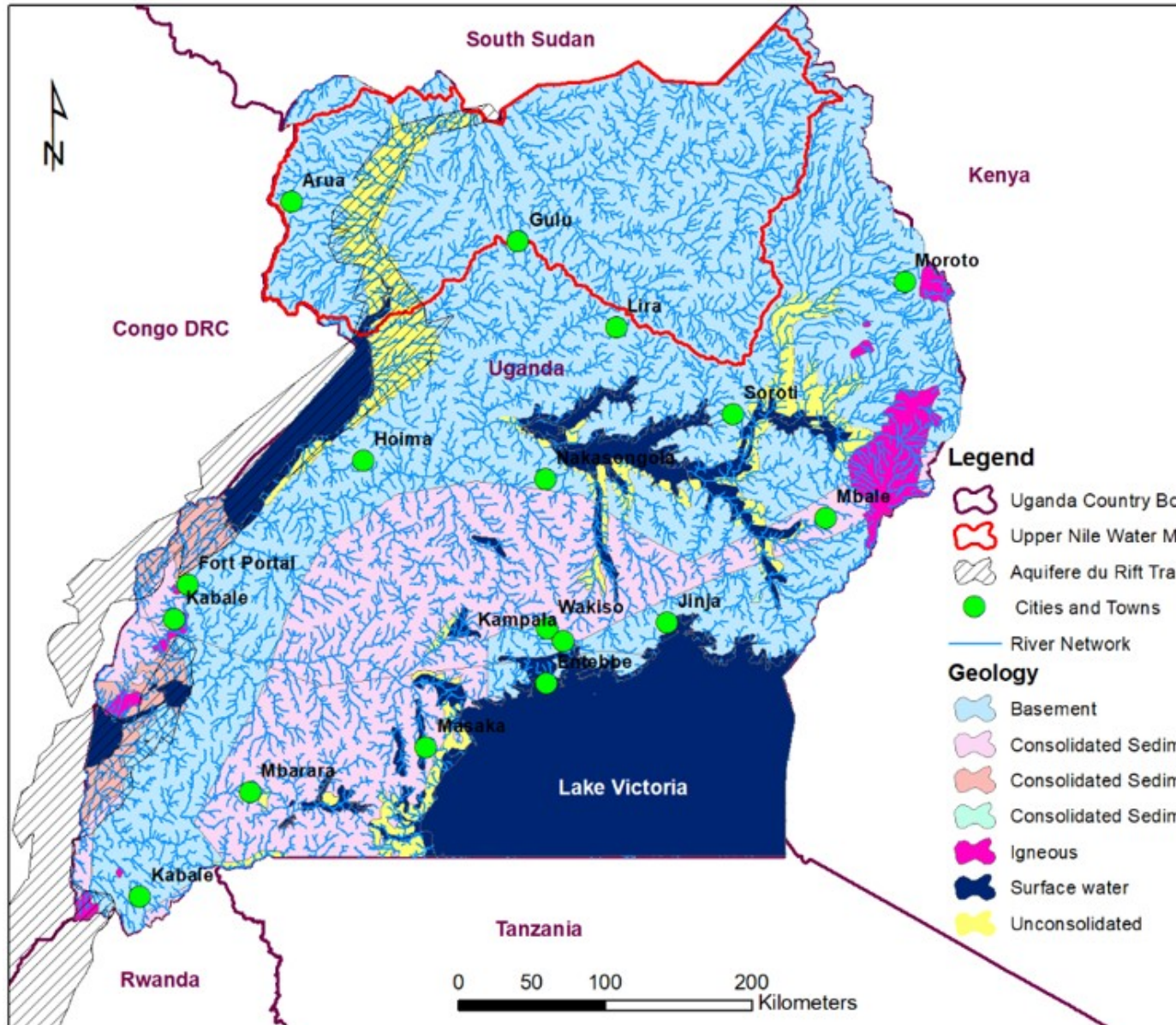


Figure 6 Upper Nile Water Management Zone (UNWMZ) and Aquifere du Rift Transboundary Aquifer.

Groundwater is key to human consumption and agriculture production. Groundwater is the most important source of water for domestic use in rural areas in Uganda, including the UNWMZ, where it accounts for 70-80% of the total water supply (MWE, 2018). Groundwater is also an important source of water for irrigation, particularly in areas where surface water resources are limited (mostly in the northeastern and eastern parts of the country, and parts of the western and southwestern regions). This dependency is expected to increase significantly in the coming decades driven by the impact of growing population, urbanization and climate change, which led to the selection of Uganda as a case study for this project.

There is potential to further develop groundwater but there are also areas experiencing over-abstractions. Preliminary assessments of the status of groundwater resources (MWE, 2015; MWE, 2018) indicate that Uganda has a large untapped groundwater potential in the northeastern region and parts of the northern (e.g., e.g., districts, of Gulu, Kigumer), which overlap with the UNWMZ. This groundwater potential could be used for increasing access to and reliability of drinking water supply and expanding irrigation, as well as smoothing out shortfalls in surface water supply during drought periods in conjunctive use systems. However, these assessments also indicate that there are some areas where groundwater resources are being overexploited, across the central, southwestern and western parts of the country. Within the UNWMZ, the groundwater potential is also smaller across some parts like Yumbe district, which hosts one of the largest refugee settlements in the world i.e., Bidibidi (Scherrer et al., 2021). In many of these district areas, the demand for water has exceeded the recharge rate of aquifers, leading to declining water levels and deteriorating water quality. This has resulted in increased pumping costs and reduced availability of water for domestic, agricultural, and industrial uses.

Groundwater availability will decline. When looking into the future, groundwater resources in Uganda are likely to decline due to the joint impacts of increased abstractions and climate change, with a decrease in recharge rates and increased variability in rainfall patterns. Water quality issues, such as increased salinity and contamination, are likely to emerge due to over-abstraction and insufficient sanitation facilities in rural areas (Awange et al., 2018).

Groundwater-Dependent Ecosystems are at-risk. Climate change and increasing groundwater extractions are projected to have significant implications for groundwater-dependent ecosystems in Uganda. Wetlands are one such ecosystem that is particularly vulnerable. Wetlands play a vital role in regulating water flow, maintaining water quality, and supporting biodiversity in Uganda. However, increased groundwater extraction for agriculture and other uses, as well as climate change-induced changes in rainfall patterns, are leading to a decline in wetland areas and changes in their functioning. For example, the Nakivubo wetland in Kampala, Uganda's capital, has been heavily impacted by increased groundwater extraction and urbanization. Between 1991 and 2001, the wetland area decreased by 45%, with the remaining wetland areas heavily polluted due to increased human and industrial activities. As a result, the wetland's capacity to regulate water flow and maintain water quality has been significantly reduced, with implications for downstream ecosystems and human populations that rely on these resources.

There is scant coverage of groundwater in basin planning in the UNWMZ. The UNWMZ has two catchment management plans (CMPs), which contain a simple diagnosis of surface and groundwater availability and water demand under the current situation and drought scenarios, along with an institutional assessment of the regulatory frameworks, and program of measures intended to support the further implementation of IWRM principles. The program of measures of the two CMPs contains actions that are directly connected to the G4DR and which fall under the supervision by the Directorate of Water Resources Management (DRWM) within the Ministry of Water and Environment. Such actions include establishing a GIS-based knowledge and information management system, developing detailed hydrogeological studies on aquifers, assessing drought risk, and building technical capacity for the determination and implementation of environmental flows. The results of this work will guide

further work related to updating of existing catchment management plans and preparation of new CMPs.

Detailed assessment of groundwater resources can support the realization of catchment management plans, but there is need to reconcile diverse groundwater assessment methods. The DWRM is spearheading preparation of the new CMPs to guide investments in the management and development of water and related resources. One important improvement with respect to the earlier CMPs, is to expand the assessment of groundwater and surface water resources and the development of water balance models. It has been noted that there are inadequacies in methodologies for assessing groundwater resources. Thus, the quantity and role of groundwater resources in catchment water balance are poorly understood resulting in gaps in water resources analysis. G4DR project support will therefore be used to develop and test methodologies for detailed assessment of groundwater resources and its integration in catchment water balance in support of preparation of catchment management plans. Such groundwater assessments in the UNWMZ are particularly required for planning purposes given that groundwater is the most important source for drinking purposes, and it could play a major role in the future irrigation development plans. Such an effort will support and complement other ongoing projects led by the Ministry of Water and the Environment such as the IWMDP World Bank dealing with the development of a national assessment of groundwater resources and a strategy to support its sustainable development, and ongoing projects led by IIASA on developing tools and approaches to tackle water quality in Uganda (see Table 4).

Mono River Basin: Fostering groundwater-based planning in a newly formed River Basin Organization (RBO)

Mono River Basin and Dahomey Coastal Aquifer. The Mono River Basin is a transboundary river basin located in West Africa, shared by the countries of Benin and Togo (Figure 7). The basin covers an area of approximately 24,300 km². The Mono River originates in the highlands of northern Togo and flows southward for more than 500 kilometers, eventually entering Benin and discharging into the Gulf of Guinea. There are several groundwater aquifers in the Mono River Basin, including the Dahomey Coastal Aquifer, the Precambrian Basement Aquifer, and the Voltaian Basin Aquifer System. The Dahomey Coastal Aquifer is the largest and most productive aquifer in the basin and is located primarily in Benin. It covers an area of about 65,000 km² and consists of unconsolidated sedimentary rocks.

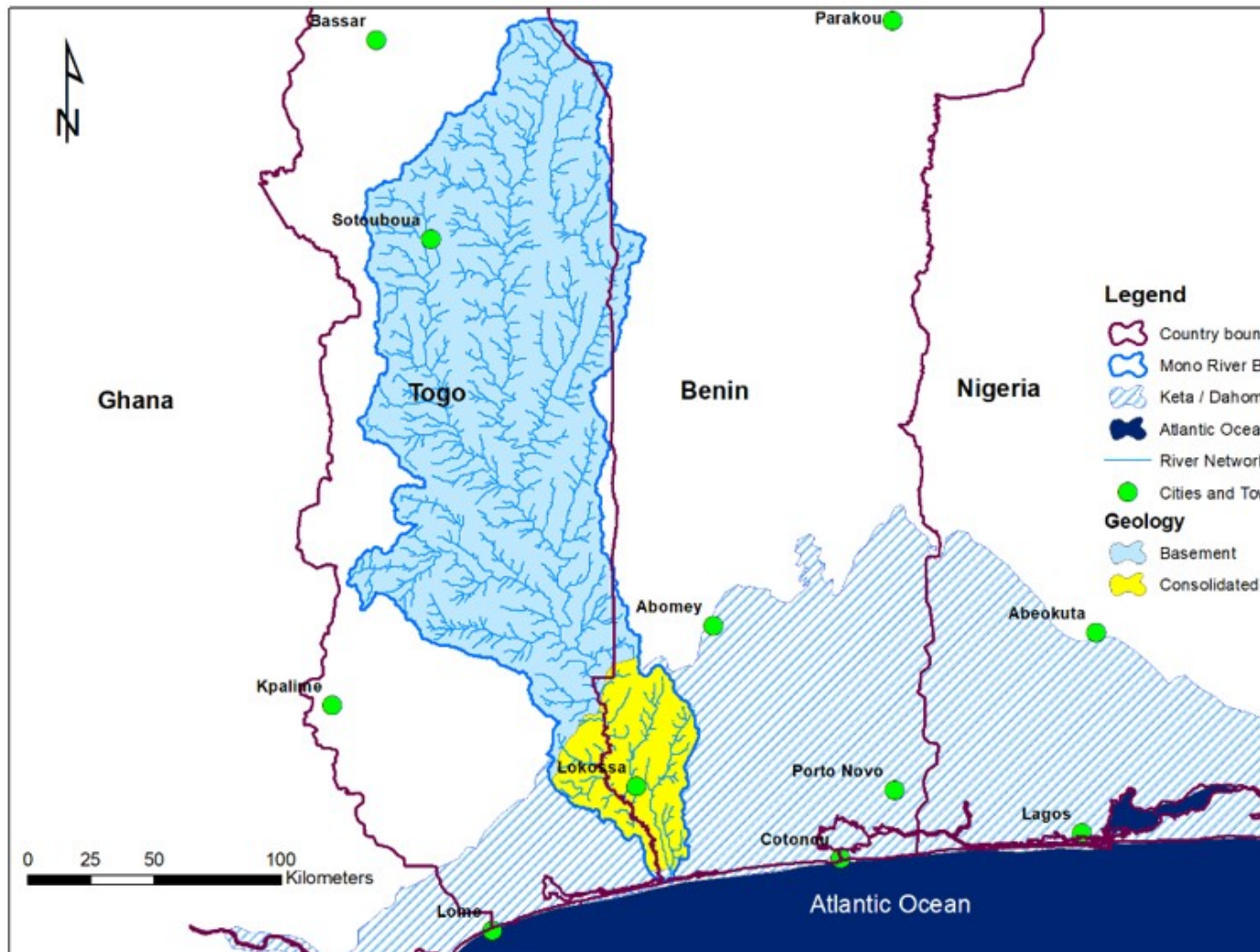


Figure 7 Mono River Basin and Dahomey Coastal Aquifer

Changing climate in the Mono. The Mono River Basin is characterized by a tropical climate, with high levels of precipitation during the rainy season, which runs from April to October. Rainfall in the Mono River Basin is highly variable, with the amount of rainfall varying significantly from year to year, resulting in frequent droughts and floods. For example, in 2008, the region experienced a major flooding event that affected over 200,000 people and caused significant damage to homes and infrastructure (CRED, 2021). Climate change is expected to have significant impacts on the Mono River basin, with projections indicating changes in temperature, precipitation, and hydrological patterns.

- **Temperature:** Mean annual temperatures in the region are projected to increase by between 1.5°C and 4.5°C by the end of the century, with higher temperatures expected in the dry season (IPCC, 2014).
- **Precipitation:** Projections for changes in precipitation in the Mono River basin are more uncertain, with some models suggesting that precipitation may increase slightly, while others

suggest a decrease. However, most models agree that extreme precipitation events are likely to become more frequent (IPCC, 2014).

- Hydrological patterns: Changes in temperature and precipitation are expected to alter the hydrological patterns of the Mono River basin, with increased evapotranspiration, reduced river flow, and changes in the timing and duration of the wet and dry seasons. In addition, there may be decreased groundwater recharge.

There is growing groundwater use, but also potential for additional development. The Mono River basin supports a variety of livelihoods in both Togo and Benin. Main livelihoods on the Togo side of the Mono River basins are agriculture (e.g., maize, cassava, yams, and vegetables), fisheries, and livestock (FAO, 2021). In Benin the main livelihoods are agriculture (e.g., maize, cassava, yams, and rice), fisheries, and salt production (FAO, 2021). Groundwater is often used for irrigation during the dry season when water is scarce, but this can also affect the availability of water for domestic use. In the Dahomey coastal aquifer, groundwater withdrawal accounts for only 20% of the recharge (UNESCO-IHP and UNEP, 2016).

Emerging water quality concerns may compromise ecosystem functions. Amoussou et al. (2016) found that the water quality in the Mono River has deteriorated over time, with high levels of organic pollution and heavy metals, which pose risks to human health and aquatic life. There may be a critical interaction between floods and pollution that requires attention. While there is limited research on the specific ecosystems in the Mono River basin that depend on groundwater, several studies emphasized that the loss or degradation of wetlands could have significant impacts on the biodiversity and ecological functioning of the Mono River basin.

Growing project activity, but limited data & monitoring to support holistic management. There is limited data available on the amount of groundwater extraction and the purposes for which groundwater is being used in the Mono River basin. GIZ is currently (2023-2025) implementing a project focused on advancing an Observatory for the Mono; their focus is on surface water data primarily. A GEF funded project entitled RIWE-Mono project which is aimed at improving the management of the Mono River Basin; undertaken in collaboration with the OSS, the project will develop a TDA, SAP and implement a set of pilots. The project will also work toward realization of water monitoring frameworks but stop short of implementation of actual monitoring. The project includes key activities such as improving water quality, restoring degraded ecosystems, and promoting sustainable agriculture practices (GEF, 2021). No pilot activities are explicitly recused on groundwater, like well rehabilitation. Finally, a large adaptation fund project is expected to launch in 2024, centered on providing a climate shield to the basin through a set of activities; groundwater appears considered but not central to this project. To complement these and other activities, it is critical to bring groundwater to the forefront of planning in the Mono to achieve more holistic and sustainable solutions. As it concerns to groundwater, key attention may be paid to complement existing efforts by improving management based on improved and integrated monitoring, exploring the potential of MAR to mitigate floods and droughts (Dillon et al. 2020), and identifying and addressing wells at risk of water supply contamination due to floods. Related, contribution of data to populate groundwater databases into the Mono Basin Observatory can improve the knowledge base for decision-making in the basin.

Table 3: Case Study Baseline Projects

Project/Program	Lead Executing Institutions	Time period & Investment	Geographical focus (cities, country, regional)	Objective	Potential linkage to G4DR activities
Malawi Watershed Services Improvement (MWASIP)	Ministry of Water and Sanitation	2020 ? 2026 USD 160 million	Malawi	To increase the adoption of sustainable Landscape management practices and improve watershed services Focus area: Mangochi, Balaka, Machinga, Zomba, Ntcheu, Blantyre and Neno.	Medium
Building Resilience and Adaptation to Climate Change in Malawi	Consortium of non-governmental organizations and UN agencies	2021 ? 2026 25.8 USD million	Malawi	Focus area: Balaka, Chikwawa, Mangochi and Phalombe	Medium
Social Support for Resilience Livelihood Project (SSRLP)	National Local Government Finance Committee (NLGFC)	2020 ? 2025 181 USD Million	Malawi	Improve resilience among the poor and vulnerable population and to strengthen the national platform for safety nets in the Republic of Malawi.	Low

Project/Program	Lead Executing Institutions	Time period & Investment	Geographical focus (cities, country, regional)	Objective	Potential linkage to G4DR activities
Climate Smart Enhanced Public Works Programme (CS-EPWP)	Ministries for the project are Finance, Local Government, Agriculture and Gender.	2022 ? 2024 USD 128 million	Malawi	Increasing farming communities' output and quality of crops in a climate resilient and sustainable way. Funded by: Clinton Development Initiative (CDI) Focus areas: Karonga, Nkhosakota, Kasungu, Lilongwe, Balaka, Chiradzulu, Phalombe and Blantyre.	Medium
Malawi Resilience and Disaster Risk Management Project (MRDRMP)	Ministry of Water and Sanitation	2016-2024 USD 104 million	Malawi	To support the government of Malawi to meet the immediate food security and livelihoods restoration needs of the communities affected by drought and promote recovery and resilience in key affected sectors.	Medium
Building Resilience and Adaptation to Climate Change in Malawi	International Food Policy Research Institute (IFPRI)	2020 - 2025 USD 7,119,764 million	Malawi	Focus area: Balaka, Chikwawa, Mangochi and Phalombe	Medium

Project/Program	Lead Executing Institutions	Time period & Investment	Geographical focus (cities, country, regional)	Objective	Potential linkage to G4DR activities
Climate Investment Funds	African Development Bank	2021-2030 USD 380 million (for 9 countries)	Malawi	To mainstream climate change considerations into long-term policy making and in sector strategies and programs, particularly agriculture and fisheries, building institutional capacity for adaptation and disaster risk reduction, and facilitating knowledge sharing on innovative climate adaptation actions at multiple scales.	High
Development Smart Innovation through Research in Agriculture (DeSIRA)	The International Potato Center (CIP)	2019-2024 USD 6,901,580	Malawi	To improve climate change adaptation of agricultural and food systems in Malawi through research and uptake of integrated technological innovations Focus area: Mzimba, Chitipa, Karonga, Nkhata Bay, Nkhotakota, Kasungu, Salima, Mulanje, Thyolo and Chiradzulu	Low
Malawi's Climate Leaders	Scottish Government	2021 ? 2050 USD 5,000	Malawi	To support the ambition, innovation and passion of young people in Malawi to be catalysts of change towards a sustainable, low-carbon and climate resilient future	Low

Project/Program	Lead Executing Institutions	Time period & Investment	Geographical focus (cities, country, regional)	Objective	Potential linkage to G4DR activities
Advancing the NAP process: Climate Resilience for Sustainable development in Malawi	Environmental Affairs Department	2019 ? 2024 USD 2,559,930 million	Malawi	To develop Malawi's National Adaptation Plan	Low
WASCAL Programme: Hydrometeorological observation of transboundary basins.	University of Abomey Calavi (Benin) University of Lomé (Togo)	2024-2026, Euros 250 million	Benin and Togo	Training, acquisition and installation of Hydrometeorological measurement equipment in the Mono basin.	High
RIWE-Mono: Regional Initiative for Water and Environment in the Mono River Basin	Mono Basin Authority (MBA)	2024-2027, Euros 5 million	Benin and Togo	Generate global environmental benefits through enhanced cooperation between Togo and Benin on the Mono River Basin	High
WACA Project - West African Coastal Resilience Investment Project	Ministries of the Environment (Benin and Togo)	2024-2027 USD 50 million	Benin and Togo	Contribute to improved management of shared resources and risks integrating climate change affecting communities in the south and coastal area of the basin. Regional Lower valley of the Mono Basin (Benin-Togo)	High

Project/Program	Lead Executing Institutions	Time period & Investment	Geographical focus (cities, country, regional)	Objective	Potential linkage to G4DR activities
BRIDGE "Building dialogue and governance around rivers?"	Mono Basin Authority (MBA)	2023 ? 2027 Euros 1 million	Benin and Togo	Complementarity and reinforcement of the actions of component 3 of the present initiative with regard to the MBA capacity building. The Bouclier project will definitely consider the results and achievements of this project and build on them when planning the various stakeholder capacity building activities.	High
Lower Mono River Valley Development Project	Regional Benin-Togo	Euros 10 million	Benin-Togo	Contribute to the improvement of food security and poverty alleviation of rural populations	Low
Mono Transboundary Biosphere Reserve Management Project	Regional Lower part of the basin	2022-2026 Euros 10 million	Benin-Togo	Improving the conservation of marine and coastal ecosystems and the use of ecosystem services	Low
Project for the hydro-agricultural development of the Lower Mono Valley	Government of Benin Ministry of agriculture	2022-2027 Euros 10 million	Benin	Strengthen food self-sufficiency and improve the standard of living of rural populations by developing an agricultural perimeter with total water control for the cultivation of rice and market garden produce	Medium

Project/Program	Lead Executing Institutions	Time period & Investment	Geographical focus (cities, country, regional)	Objective	Potential linkage to G4DR activities
Project for the development of multifunctional hydraulic infrastructures and sustainable management of water resources (PDIHM/GDRE)	Regional Benin-Togo (MBA)	USD 5 million	Benin	To provide climate information and early warnings	Low
Bouclier Climate Mono Adaptation Found (AF)	Basin Authority (MBA), Togo: Ministry of Water and Rural Hydraulics; Benin: Ministry of Water and Mines	2024-2028 USD 14 million	Benin and Togo	The overall objective of the project is to strengthen the resilience of vulnerable communities in the Mono River Basin through building adaptive capacity to the risks of recurrent flooding and promoting the sustainable and equitable use and management of water resources and related ecosystems	High
Development of hydro agriculture downstream of the Nangbeto dam	National Togo	2022-2026 USD 20 million	Togo	To strengthen the capacity of institutions in Togo and to set up an information system to fulfil the enhanced transparency requirements of the Paris agreement	Medium

Project/Program	Lead Executing Institutions	Time period & Investment	Geographical focus (cities, country, regional)	Objective	Potential linkage to G4DR activities
Assessing and managing the use of Groundwater Resources and Developing a Strategy and Policy for Sustainable Development and Management of Groundwater Resources in Uganda	IWMDP World Bank	2021-2024 USD 1.87 million	Uganda	This baseline project aims to quantify available groundwater resources in view of climate change and human impacts, assess the threats to groundwater resources, assess the current and future groundwater demands for various uses, and propose strategies and a policy for ensuring that groundwater resources are developed and managed in a sustainable manner.	High
Enhancing resilience of communities to climate change through catchment based integrated management of water and related resources in Uganda (EURECCCA).	Sahara and Sahel Observatory (SSO) and Ministry of Water and Environment of Uganda	2017-2024 USD USD 6.9 million	Uganda	This baseline project aims to increase the resilience of communities to the risk of floods and landslides of Awoja, Maziba and Aswa Catchments through promoting catchment based integrated, equitable and sustainable management of water and related resources.	Medium

Project/Program	Lead Executing Institutions	Time period & Investment	Geographical focus (cities, country, regional)	Objective	Potential linkage to G4DR activities
Strengthening drought resilience of small farmers and pastoralists in the IGAD region (DRESS-EA).	Sahara and Sahel Observatory (SSO), Global Water Partnership Eastern Africa (GWPEA) and Ministry of Water and Environment of Uganda	2021-2025 USD 1.6 million	Uganda	This baseline project targets the improved resilience of smallholder farmers and pastoralists to climate change risks related to drought in Karamoja sub region. Focus area: Lokere catchment in Kyoga Water Management Zone	Medium
Enhancing resilience of communities and fragile ecosystems to climate change risk in katonga and mpologoma catchments.	Global Water Partnership Eastern Africa (GWPEA) and Ministry of Water and Environment of Uganda	2021-2025 USD 17.3 million	Uganda	The objective of this baseline project is to enhance the resilience of vulnerable communities and fragile ecosystems to climate change risk related to floods in the Katonga and Mpologoma catchment areas. Focus area: Katonga and Mpologoma catchments in Victoria and Kyoga water management zones respectively.	Medium
Sustainable water quality management supporting Uganda's development ambitions (SWAQ-Uganda)	IIASA	2022-2025 Euros 0.6 million	Uganda	This project is assessing national water quality in Uganda and developing water quantity and quality modelling tools for Uganda.	High

Project/Program	Lead Executing Institutions	Time period & Investment	Geographical focus (cities, country, regional)	Objective	Potential linkage to G4DR activities
Inventive forecasting tools for adapting water quality management to a new climate (Inventwater)	IIASA	2020-2024 Euros 4 million	Uganda	This project is developing water quality modelling tools with application to the Lake Victoria Basin.	High

3) The proposed alternative scenario with a brief description of expected outcomes and components of the project and the project's Theory of Change.

G4DR aims to enhance water security and resilience in Africa by unlocking the potential of sustainable groundwater development and protection. It will do this through support to AMCOW and its groundwater program (APAGroP) and build and work through the network of RECs to strengthen groundwater-based planning in order to enhance beneficial and sustainable groundwater use, groundwater governance and conjunctive management. The project responds to continental and regional demand for greater incorporation of groundwater into planning to realize the continent's socioeconomic development goals and is the result of extensive consultation with relevant actors across multiple scales and sectors. Related, to maximize impact and foster partnership and synergy, the project will be executed through an integrated hub-and-spoke institutional framework through which collaboration will be promoted across continent, region and case studies. To foster ownership and sustainability, project activities will directly support the aims of key regional bodies such as AMCOW, OSS, and SADC-GMI and be undertaken in coordination with key development partners such as BGS, BGR and CIWA.

Responding to demand. There is widespread recognition of the potential for groundwater to play a greater role in Africa's sustainable development. Reflecting this recognition, AMCOW and the AU have prioritized action on groundwater development and governance for securing resilience and socioeconomic transformation in Africa, with specific calls for recognizing the role of groundwater, increasing investment, fostering cooperation and engaging with APAGroP. In Africa's sub-regions, IGAD, OSS, and SADC-GMI have been created with similar aims and have made key progress. In countries, there is generally acknowledgement of the greater role groundwater can play. Finally, the key actors in the development community such as BGR, BGS and the World Bank/CIWA have placed more emphasis on groundwater in Africa and have converged toward the opportunity for AMCOW to drive a framework that promotes greater visibility and use of groundwater in Africa. The G4DR project enters into this context, to support this diverse set of actors to realize their aims.

Partner Consultation. Consultation in the development of the Project Preparation Grant (PPG) was extensive. AMCOW was part of the core design team, involved in numerous discussions with other executing agencies, and involved in the inception and validation workshops. Multiple meetings were

held with regional centers namely SADC-GMI, IGAD and OSS in order to find ways in which the G4DR project can link and support their aims; such interactions with regional centers were likewise crucial in selecting case studies. In terms of case studies, multiple prolonged interactions ? as well as many quick and focused ones ? were implemented with case study partners such as the Mono Basin Authority, Ministry of Water and Environment in Uganda, DGNRH in Mozambique, and Department of Water in Malawi. Finally, multiple calls and email exchanges were undertaken with development partners like BGS, BGR, IGRAC, and the World Bank/CIWA. This engagement has been fundamental to the conceptualization and design of the G4DR program of activities.

Ensuring institutional partnership in project implementation. AMCOW, through its APAGroP program, will drive policy documents and requests for recommendations and provide an overarching institutional umbrella and strategic direction on the G4DR project. Regional centers will coordinate activities in their regions, providing lessons, models and guidelines which will feed into AMCOW documents and deliberations. Case study partners will drive and execute activities hand-in-hand with core executing partners and regional centers. Finally, key development partners will be integrated through participation in events and collaboration on sustainable financing. Concretization of such partnership will be achieved through:

- Direct subgrant to AMCOW to ensure sustainability of Groundwater Desk Function
- AMCOW leadership and co-leadership of several activities
- Collaboration with OSS in execution of Mono Basin activities
- SADC-GMI to lead activities on cross-pilot learning and exchange
- Collaboration with IGAD in the context of IGAD-led G4DR project, specifically in the areas of Knowledge development (C2), Capacity building (C2), Databases (C2), and Lesson sharing across case studies (C3)
- Case Study partners to co-lead designated activities in pilots on topics such as borehole drilling and well rehabilitation
- Ongoing collaboration with select development partners ? e.g., BGR, BGS, and the World Bank ? through partner forum in AMCOW coordination framework
- Project Management Unit (PMU) hosted by SADC-GMI.

Harnessing IWMI and IIASA's capacities to empower AMCOW, regional centers & countries.

IWMI bridges science and policy with years of expertise in advancing cross-sector water management approaches and co-implementation of approaches to shared aquifer management. IIASA's experience in stakeholder engagement and cross-sector modeling, and can provide support and transfer of approaches and knowledge. Together, the two institutes will partner to strengthen AMCOW, regional centers and countries through by applying both IWMI's extensive experience in implementation of research for development projects on groundwater and shared waters in Africa, as well as IIASA's knowledge and capacity development expertise. These institutional strengths will be leveraged to support AMCOW, regional centers and countries through codesign of activities that create a more enabling framework for groundwater-based planning and show the benefits of that framework through pilot activities. A suite of activities will indeed be collaboratively implemented in areas such as lesson-learning, policy and guideline development, groundwater monitoring, well rehabilitation, and water quality assessment. IWMI and IIASA will bring particular value in controlling the quality of activities and offering systematic perspectives that consider how activities fit together to achieve a wider impact.

Project Outcomes. In simple terms, project success will be gauged by the direct water security and resilience benefits achieved through enhanced consideration of groundwater in planning. More profoundly, the project will achieve success if it strengthens processes and systems across institutions and scales so that the promotion of groundwater in planning and management is sustained. Key outcomes are as follows:

- Coordinative framework for cross-scale interaction on groundwater in Africa that accelerates adoption of groundwater resilience solutions
- AMCOW Groundwater Desk Function is sustained and empowered to catalyze greater incorporation of groundwater into planning in Africa
- Enhanced evidence that guides improved decision-making on groundwater opportunity and risk in Africa
- Groundwater incorporated into basin planning in 3 case studies
- Groundwater data platforms established in 3 case studies
- More than 26 000 ha under improved water management
- More than 34,200 direct beneficiaries of capacity enhancement and improved water management

Ensuring Sustainability. Ensuring that project outcomes extend beyond the life of the project is critical. Several steps will be taken to promote post-project sustainability. First, as noted, the PMU will be embedded in SADC-GMI to foster ownership by regional centers and AMCOW. Second, as noted above, a set of key activities will be led or co-led by AMCOW, regional centers and country ministries. Third, development partners will be brought into the fold of the project, with strategic partners added to the project steering committee, to promote sustainable finance to regional bodies. Fourth, executing partners will seek to foster a positive synergy in working together that sustains itself beyond the project. For example, pilot activities will be nested in the context of regional centers and undertaken in partnership with AMCOW; their progress and results will be channeled up vertically for promotion and exchanged horizontally for lesson-sharing and synthesis of experience. Finally, the project will seek to dedicate focus to realizing and disseminating clear-cut real outcomes, with the belief that achieving real outcomes that provide practical benefit will provide a key incentive to continue.

Project components. Aligning with the key themes in AMCOW's White Paper, the project is structured into five components:

- Strategic Planning: Supporting the African Ministers' Council on Water (AMCOW), through their Pan-African Groundwater Program (APAGroP).
- Evidence and Capacity for G4DR in Africa: Identifying aquifers that present risk and opportunity to enhance resilience, as well as populations/socio-economic contexts in Africa informing investments.
- Demonstrating benefit: Utilizing evidence-based planning to realize on-the-ground impacts in pilots.
- Incorporating G4DR into pan-African Youth Forums: enhancing the beyond-project capacity, outreach, networking, and uptake of long-term workable and sustainable strategies and solutions.

- Supporting Knowledge Management and M&E: Supporting capture, exchange and dissemination of key project advancements, as well as evaluation of project progress relative to targets.

Project Objective and end-of-project outcomes. As shown in the project's Theory of Change (ToC), the project will enhance water security and resilience in Africa by unlocking the potential of sustainable groundwater development and protection. As noted above, end of this project goal in terms of this objective will be direct improvements to water security and resilience achieved through enhanced consideration of groundwater in planning, as well as strengthened processes and systems across institutions and scales so that the promotion of groundwater in planning and management is sustained. Five components will achieve this goal along corresponding causal pathways, each addressing a distinct key barrier.

Enhanced Governance. The first pathway is defined by Component 1 and aims to overcome the insufficiently developed groundwater governance in the region (Barrier 1). At the core of this component is the strategic support of AMCOW and its mandate to support RECs, RBOs, and Member States to achieve water security and resilience with improved and more inclusive groundwater planning and management. Key levers to foster this outcome of strengthened governance include lesson-learning across basins and countries, support tools and increased awareness. Outcomes will equally support an improved policy context for introducing groundwater solutions in Africa and foster the cross-scale linkages necessary for optimal realization of groundwater-based solutions. The core assumption for achieving change through implementing this causal pathway is that countries, RECs and member states continue to collaborate with AMCOW and that all relevant stakeholders engage with AMCOW to co-develop the relevant governance processes.

Learning to foster evidence-based decision-making. The second pathway aims to overcome limited knowledge to support groundwater-based planning and investment. Component 2 will thus focus centrally on fostering informed decision-making and enhancing capacity of decision-makers in RECs, RBOs and countries. This will be done through co-creation of knowledge and policy products on groundwater risks and opportunities, and dedicated trainings in key topics to aid knowledge acquisition. Enhanced knowledge generation and lesson exchange will increase awareness on the opportunities and risks related to groundwater, and capacity strengthening activities will enable stakeholders across scales to process such information so that it can be applied. A key assumption for this causal pathway is that data and experts are available to establish the evidence relevant for groundwater related planning processes across Africa and within the three focus sites.

Piloting solutions to realize impacts and generate evidence. The third pathway aims to address the dearth of experience in groundwater-based planning. Pilots will be implemented in the three target areas (Shire aquifer, Uganda, and the Mono basin aquifer) centered on incorporation of groundwater into basin planning. While there is some variation in specific ways this end will be achieved across pilots, commonalities such as data integration & stakeholder involvement are constant. Related, to foster cross-pilot learning and generate an evidence base for further roll-out of groundwater into planning, cross-pilot study tours will be undertaken and a community of practice will be created. Specific attention will be paid to ensuring the inclusion of female and youth voices in this process. This

causal pathway assumes the buy-in of important stakeholders in all three case study areas as well as the availability of co-finance to enable the implementation of solutions.

Fostering inter-generational change. The fourth pathway aims to address the lack of awareness of groundwater planning and benefits among youth. As such, the fourth component centers enhancing capacity of youth to consider social and cross-sectoral aspects of groundwater. This aim will be achieved through creation of a youth forum and by harnessing various other social media platforms. Engaging with youth organisations introduces an inter-generational perspective and helps build awareness and capacity early on to ensure the long-term improvement of groundwater management. These activities will support the formulation of joint strategies and action programs ensuring the long-term improvement of groundwater management. A core assumption of this causal pathway is that youth organisations are interested in groundwater management and that they engage in relevant planning processes.

Enhancing visibility. Finally, visibility and performance evaluation will be supported through knowledge management, monitoring and evaluation activities in Component 5. This will be done through knowledge management and dissemination, and adaptive results management. All five components combined will sustain and institutionalize effective groundwater planning across Africa with experiences continued to be disseminated. The youth focus of Component 4 will play a critical role in achieving this medium-term goal. In the long term, activities implemented by the project will stimulate self-sustaining processes that will lead to a continuous expansion of groundwater management investments, which will further accelerate the improved resilience of communities and sustainable development across Africa.

Building on related work. The project components directly address challenges of improving groundwater governance identified by the FAO-led Global Groundwater Governance Project and detailed in the Framework for Action; namely, the importance of identifying and empowering a lead agency through adequate finance and strengthening capacity development; ensuring accurate data, information and knowledge; appropriate policy development and political support; participatory planning and stakeholder consultation including river basin organizations (FAO, 2016). Furthermore, the project components and outcomes complement FAO's Four Betters Strategic Framework, through strengthening groundwater and agriculture food systems resilience in Africa to promote better production, enhance nutrition, and improve health and lives while creating a better environment. Furthermore, the project directly complements GEF International Waters objective to enhance water security in freshwater ecosystems (GEF 7 Objective 3).

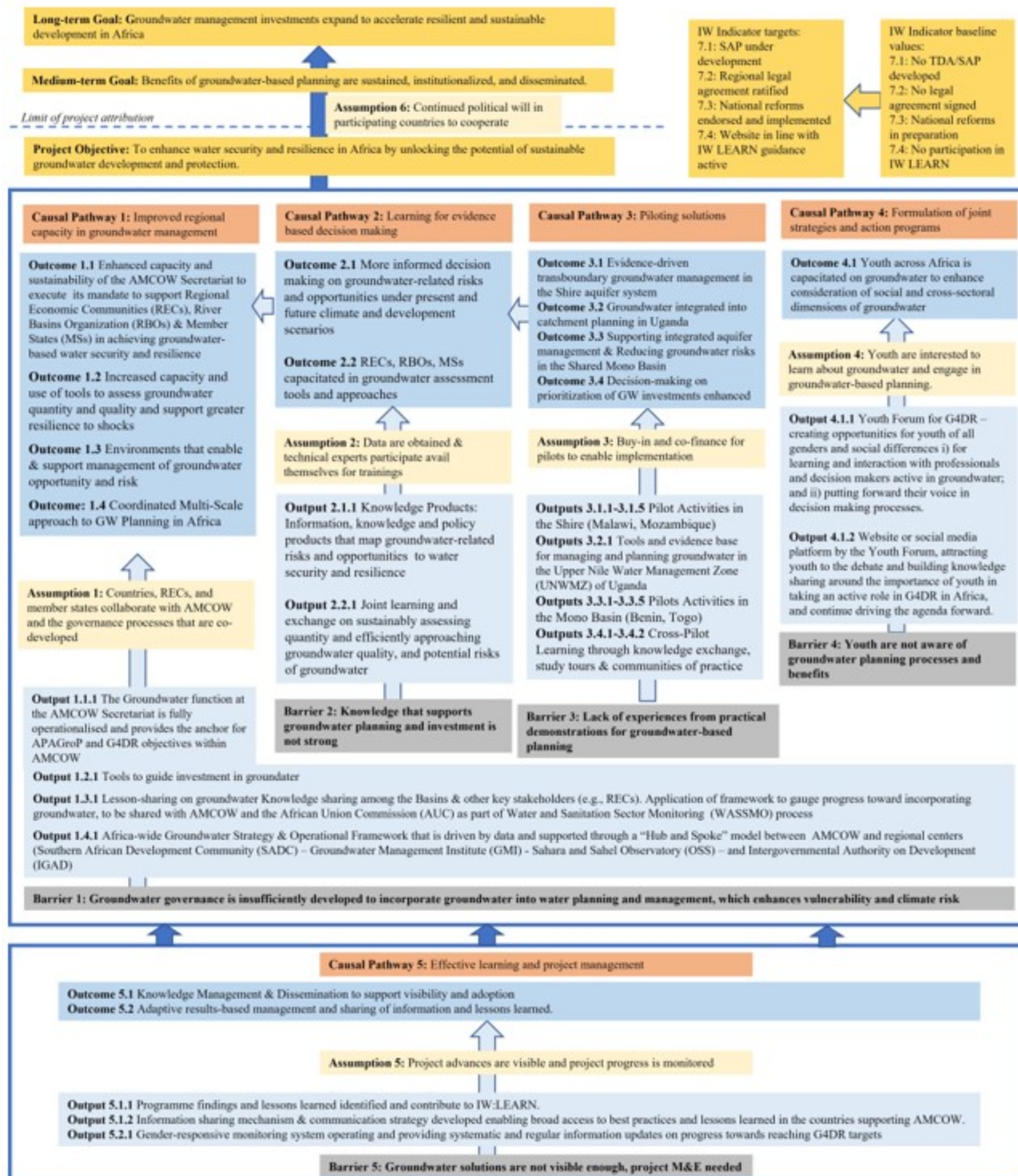


Figure 8: Theory of Change

COMPONENT 1: Strategic Planning ? Supporting the African Ministers? Council on Water (AMCOW), through their Pan-African Groundwater Program (APAGroP), to strengthen planning and investment that incorporates groundwater (Lead: AMCOW & IWMI)

Outcome 1.1: Enhanced capacity and sustainability of the AMCOW Secretariat to execute its mandate to support Regional Economic Communities (RECs), River Basins Organization (RBOs) & Member States (MSs) in achieving groundwater-based water security and resilience) (responsible: AMCOW & IWMI)

Output 1.1.1 The Groundwater function at the AMCOW Secretariat is fully operationalised and provides the anchor for APAGroP and G4DR objectives within AMCOW(responsible: AMCOW, IWMI & IIASA)

- *Activity 1.1.1.1:* Groundwork will be laid for sustainable financing of the AMCOW Groundwater function through development of a resources' mobilization strategy and business plan, based on a partner mapping exercise. This will support the identification of best-bet options for sustainable support to AMCOW groundwater activities. Enlisting key development partners in this effort, the plan will include various income scenarios and diversification options.
- *Activity 1.1.1.2:* To support the ongoing dialogue necessary to foster discussion that continues to generate ideas for new activities and the support required to realize them, a Partners Forum will be strengthened in the context of existing AMCOW coordination clusters. African Groundwater Network (AGNs) and actors will be mobilized towards a common, harmonised, and evidence-based approach to sustainable groundwater use and management in furtherance of the Africa Water Vision 2025; the SDGs and AU Agenda 2063. This will include engagement with networks and partners including AGNs, BGS, BGR and World Bank/CIWA and major actors from the private sector to engage on support for pushing the Africa Groundwater agenda forward. By including different voices from stakeholders in this Partners Forum one can ensure that marginal voices from groups can reach platforms previously unattainable and provide input to the agenda towards more inclusive beneficiaries.

Outcome 1.2: Greater resilience to shocks through increased capacity and use of tools to assess groundwater quantity and quality (responsible: AMCOW & IWMI)

Output 1.2.1: Lesson-sharing on groundwater knowledge among basins & other key stakeholders (e.g., RECs) through the application of an assessment framework to gauge progress toward incorporating groundwater into water resources programs and plans, to be shared with AMCOW and the African Union Commission (AUC) as part of Water and Sanitation Sector Monitoring (WASSMO) process (responsible: AMCOW & IWMI)

- *Activity 1.2.1.1:* To support a structured process for measuring progress toward incorporating groundwater into planning and deriving lessons from what is working and what is not, a first activity will focus on the **Development of a Groundwater Planning Assessment Framework (GPAF)** for monitoring and evaluation of groundwater management programs and projects. GPAF will capture the extent to which groundwater is reflected in activities of programs and plans that should place focus on the resource. In addition, the GPAF will embed a focus on the transformative agenda of groundwater management programs and projects to include, address, and support the needs of women, youth and vulnerable groups within the outcomes of these programs

and projects, as well as adding a water-food-ecosystem nexus perspective. A key thrust of the framework will consider the scope and nature of policies in place for ensuring the achievement of gender equality within groundwater management and governance processes. While the focus will be on select countries, the findings of these will be scaled up to inform learning at a broader scale. The GPAF will lay the foundation for support to Member States and River and Lake Basin Organisations (R/LBOs) to conduct water resources assessments, assessing the availability of groundwater resources and the impact of climate change on freshwater availability. These efforts will also utilize the knowledge and experiences of female African scholars and practitioners in the field of policy and groundwater to inform our findings.

● *Activity 1.2.1.2:* Development of a **Methodological Guide** to support a common approach to populate the GPAF in order to assess the content of water management programs and projects. This will be critical to enable seamless and consistent data entry, which will support transparent evaluation of groundwater policy and programs in Africa. Regional entities such as SADC-GMI, OSS and IGAD will play an integral role here, through provision of examples of frameworks for lesson-sharing such as the those emerging from the SADC-GMI Policy, Legal and Institutional (PLI) Development project. They will also play a key role in provision and synthesis of key data and information. Population of the framework will include results from pilots (Shire, Mono, Uganda) from component 3 to generate insights and lessons on integrating groundwater into water planning and management in Africa, which inform decision-making and improve program and project design and implementation.

● *Activity 1.2.1.3:* **Stakeholder interaction** will be essential to support this process, to foster input on design of the framework, transmission of data to populate it, and engagement around lessons that emerge from results. As such, the third activity will focus on dialogues to support the co-design of the GPAF and engagement on results of framework application. This activity will ensure that poly-vocal inputs including those from women, youth and vulnerable groups from all sectors (agriculture, energy, environment, etc.) are included in a way that informs not only the data input to the GPAF, but also the design and application of the GPAF itself. Such efforts will be frequently linked with those of activity 1.3.1.3. Activities in this output will build on existing events at regional and continental levels to support a coordinating platform of engagement and peer knowledge sharing and reporting, which will in turn support the existing Water and Sanitation Monitoring (WASSMO) reporting platform. Related, effort will be made to ensure this reporting platform receives due visibility, and proper quality control through coordination with FAO-AQUASTAT. Such linkage should also help promote consideration of groundwater in the context of agricultural water management.

Outcome 1.3: Environments that enable & support management of groundwater opportunity and risk (responsible: AMCOW & IWMI)

Output 1.3.1: Adoption & application of policy guidelines on groundwater use and management, co-developed with multisectoral actors (responsible: AMCOW & IWMI)

● *Activity 1.3.1.1:* To foster convergence on inclusion of groundwater into water security and resilience planning, it will be important to co-develop policy guidelines on groundwater use and management with multisectoral actors. Guidelines will be informed by global best practice and

existing AMCOW policy mechanisms, but from actual lessons emerging from results of framework application in Output 1.2. Ultimately, policy guidelines will form the centerpiece of a first activity. These policy guidelines will be packaged and launched in a **flagship document** co-produced with key actors from different institutions (e.g. from relevant sectors such as agriculture) and who have different identity markers (gender, race, youth, etc.) at a continental and regional level; the G4DR project will produce two of such flagship documents: one in the second year of project implementation, and the second in the fourth year based on updated data.

- *Activity 1.3.1.2:* Development, refinement, application of country support tools. APAGroP is currently developing a set of Country Support Tools (CSTs) which can be used to catalyze and focus groundwater investments at a country or aquifer level. Strengthening existing tools and elaborating additional ones can help leverage opportunities for groundwater in specific contexts, and also work to empower the AMCOW groundwater activities and APAGroP by generating instruments to realize their aims. There may be a key opportunity here to leverage related support by other partners such as African Groundwater Network (AGNs) BGR, BGS and other actors.

- *Activity 1.3.1.3:* To promote visibility and awareness of such guidelines & tools and advocate for their use and adoption by AMCOW's ministers, a second activity will center on **raising awareness** through advocacy at a policy-level as well as in events, such as seminars, and webinars and outreach materials, such as brochures, infographics, and videos channeled through media outlets. Specific attention will be given to develop and enhance the understanding of decision makers and other policy-related stakeholders with regards to how the inclusion of groundwater into water security and resilience planning can improve the lives and livelihoods of vulnerable groups. To the extent possible, awareness-raising events will plug into existing fora like Africa Water Week.

Outcome 1.4: Coordinated multi-scale approach to groundwater planning in Africa (responsible: AMCOW & IWMI)

Output 1.4.1: Africa-wide Groundwater Strategy & Coordinative Framework that is driven by data and supported through a 'Hub and Spoke' model between AMCOW and regional centres (Southern African Development Community (SADC) ? Groundwater Management Institute (GMI) - Sahara and Sahel Observatory (OSS) ? Intergovernmental Authority on Development (IGAD) (responsible: AMCOW & IWMI)

- *Activity 1.4.1.1:* Development of an Africa-wide Groundwater Strategy and Coordinating Framework that outlines a 'Hub and Spoke' model between AMCOW and regional centers (Southern African Development Community (SADC) ? Groundwater Management Institute (GMI) - Sahara and Sahel Observatory (OSS) ? Intergovernmental Authority on Development (IGAD) for advancing groundwater management in Africa. The framework will likewise absorb evidence from Component 2 and support cross-scale linkage on groundwater planning and management. Elaboration of such a framework is envisioned to enhance efficiencies and reduce duplication in efforts to advance groundwater management, ultimately accelerating progress toward the shared aim of fostering greater consideration of groundwater. More broadly, this framework will outline the strategic role for the AMCOW Groundwater desk and regional COEs in the post-2025 Africa Water Vision.

COMPONENT 2: Evidence and Capacity for G4DR in Africa: Identifying areas in Africa that present groundwater-related risks and opportunities for enhancing water security and resilience (Lead: IIASA)

This component aims to conduct a continental-scale assessment of groundwater-related risks and opportunities to enhance Africa-wide and countries' water security and resilience to shocks (e.g., extreme climate events, pandemics) under current and future climate, socio-economic and demographic conditions. Activities will focus on supporting ongoing efforts by AMCOW, RBOs/RECs, Member States, development partners, and scientific community to continue building groundwater knowledge in all African countries, support policy development at the continental and country scales, benchmark water security among countries, and guide on-the-ground investment in infrastructure, institutions, information and capacity building. Possible future status of groundwater will depend on key drivers such as climate change, as well as population growth, urbanization and related demands on water resources. Care will be taken to ensure that key themes in the AMCOW White Paper – such as climate change resilience, human health, urbanization, food security, gender and social inclusion and the environment – are measured by the assessment. This assessment is necessary as groundwater scarcity (both in terms of quantity and quality) can limit drinking water supply, constrain agricultural production, manufacturing and mining activities, increase prices and production costs, disrupt supply chains, reduce demand, leading to conflicts between economic activities and other water users, and harm corporate reputation and marketability. Safeguarding water and ensuring its availability in sufficient quantity and quality is a subject of vital interest in African countries. Much of the existing databases on groundwater available at the pan-African level (e.g., UPGro, African Groundwater Portal, WHYMAP, Global Groundwater Information Systems (CGIS), among others) offer a rich, although yet uncompleted, picture of the status of groundwater resources, development potential and other key hydrogeological aspects across the continent. However, there is limited prospective assessment on the groundwater risks and opportunities that could emerge in the future when considering large drivers like climate change, socio-economic changes (population growth, urbanization, economic development) and sectoral development plans and investments. Such an assessment is needed to guide and inform strategic planning and investments to support a sustainable groundwater development agenda.

Outcome 2.1: More informed decision making on groundwater-related risks and opportunities under present and future climate and development scenarios (responsible: IIASA, AMCOW & IWMI)

Output 2.1.1: Knowledge products, information, and policy products that map groundwater-related risks and opportunities to water security and resilience (responsible: IIASA, AMCOW & IWMI)

To gain a broader picture of groundwater's potential risks and opportunities in impacting water security, resilience to shocks and the intersectoral trade-offs of water uses at the nexus among water, food, energy and the environment at various scales and in multiple contexts in Africa, G4DR will conduct a pan-African assessment of the current and future socio-economic impacts, and demographic change and climatic shocks on groundwater quantity and quality, and its demand, including assessing the role of groundwater in satisfying water demand of different water users in households, industries

(e.g., hydropower, manufacturing), agriculture and the environment. This assessment will build on the experience gained in the previous GEF-funded ISWEL project (GEF project ID 6993, led by IIASA), which investigated how population vulnerability from multi-sector risks (water, energy, land) change under climate change, socio-economic development, and poverty reduction (<https://hotspots-explorer.org/>), and also on the study of Greve et al. (2018), which assesses the uncertainty in global water scarcity assessments, and the study of Huggins et al. (2023), which connects groundwater resources with social, economic, ecological, and Earth systems.

Knowledge products that map groundwater-related risks and opportunities to water security and resilience will be essential not only for reaching and ensuring benefits to a wide variety of stakeholders, but also empowering those who need it most. It is acknowledged that gender disaggregated data is essential not only for this study, but also for gender analysis in general. As such, every effort will be made to access, collect and assimilate gender disaggregated data and incorporate this into the tools, models, scenarios and visualizations that will be developed for this output.

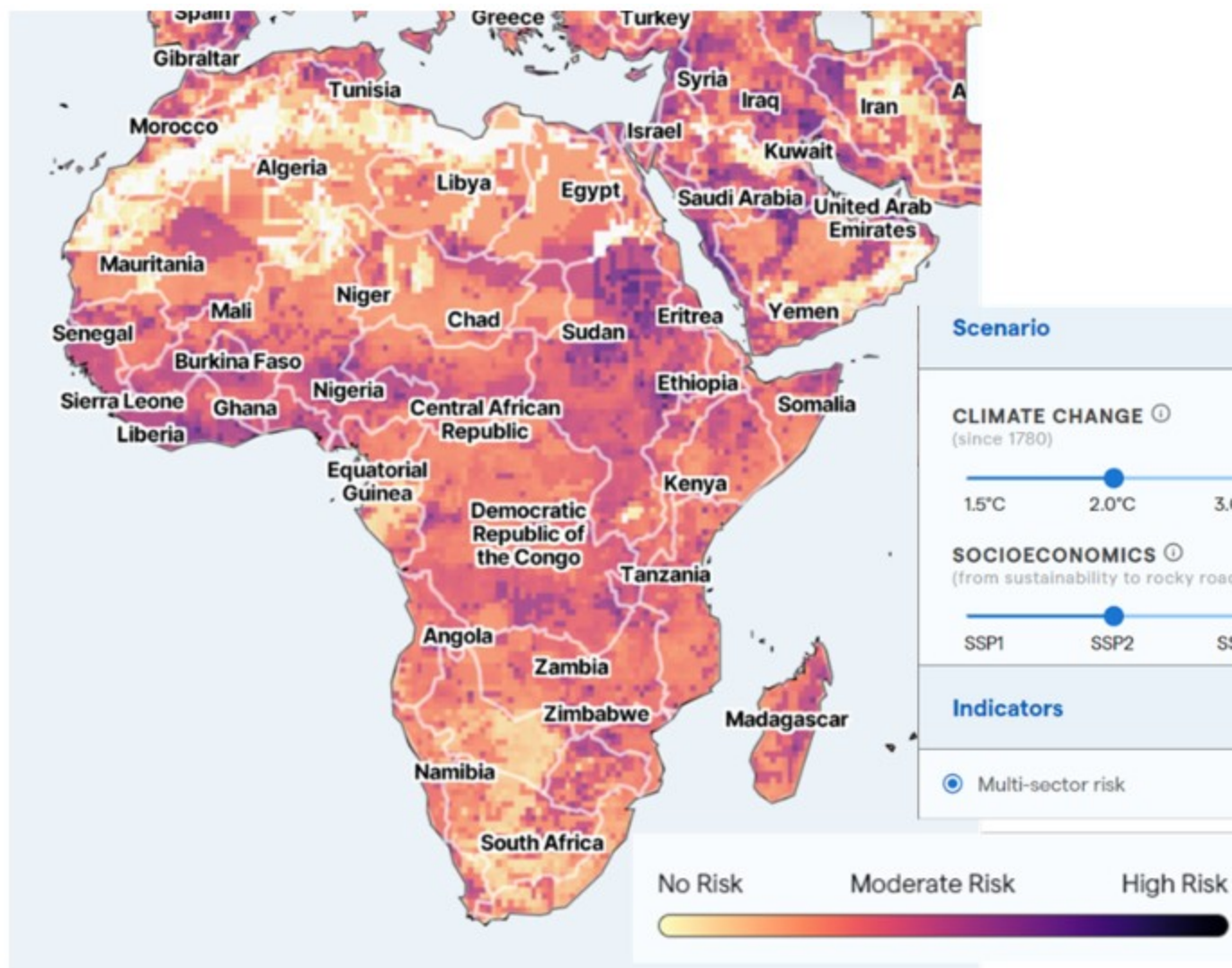


Figure 9. Multi-sector (water-energy-land) risks at pan-Africa scale under future climate and socio-economic scenarios. Source: Global Hotspots Explorer (<https://hotspots-explorer.org/>)

●Activity 2.1.1.1: Building an inventory of groundwater data in Africa (responsible: IIASA, AMCOW & IWMI)

This activity aims to build an inventory of data available for assessing groundwater resources in Africa. Previous studies assessing groundwater in Africa either at continental, national or local level, will be collected and reviewed. This inventory will gather the latest science-based data and assessments available on groundwater along with relevant policy reports describing challenges, risks, and opportunities to support a sustainable groundwater development agenda at the pan-African scale. Key policy documents such as the 2022 AMCOW White Paper, the 2018 World Bank Groundwater Assessment for sub-Saharan Africa, or the GESI water and livelihood assessment (to be developed under Activity 2.1.2), among others, will be used to inform the development of the pan-African assessment framework of groundwater-related risks and opportunities. The inventory will identify existing knowledge and available data with AMCOW, RBOs/RECs/MSs, and development partners (IGRAC, FAO, UNESCO, UNEP, BGR, BGS, etc.), together with the latest data products available from open data sources on water availability by the source of water (surface water, groundwater, non-conventional water), water quality (e.g., nitrate, arsenic and fluoride?Figure 10), sectoral water demand (agriculture, domestic, industrial), environmental conditions (environmental flow requirements, aquatic and terrestrial biodiversity, groundwater-dependent ecosystems), socio-economic settings (e.g., population density, urban-rural population shares, income levels, pumping cost), and governance arrangements (e.g., degree of IWRM implementation, groundwater monitoring). Table 5 provides a preliminary list of data sources relevant to the pan-African groundwater assessment. Consultations with partners are foreseen to refine and complete the inventory with the latest available data and explore possibilities to collect data locally. Likewise, these consultations will also be used to discuss and refine relevant future scenarios, considering current and future risks and opportunities.

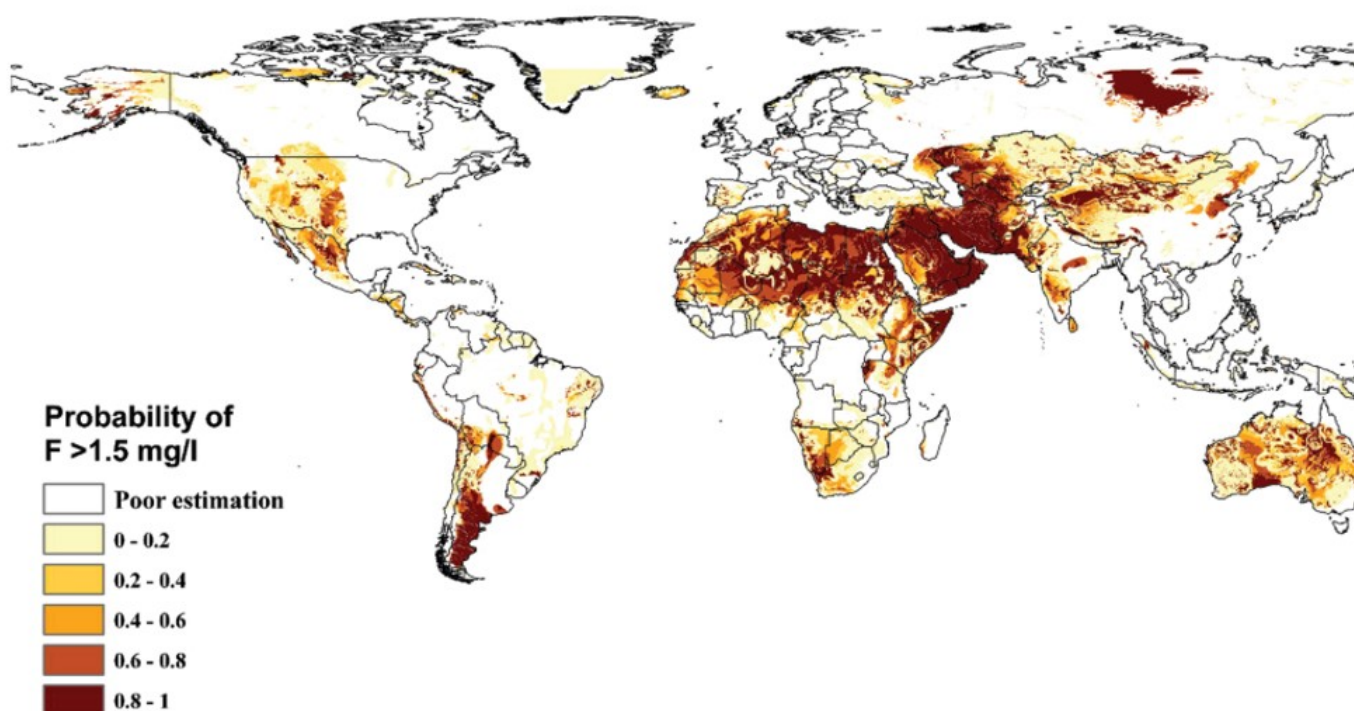


Figure 10. Probability of fluoride concentration in groundwater exceeding the WHO guideline for drinking water of 1.5 mg/L-1 (Amini et al., 2008).

This activity will be implemented largely by IIASA, supported by IWMI and AMCOW, and in close collaboration with national, regional and international partners to ensure collecting up-to-date relevant information. Discussions on collaborations on this activity with several entities who regularly collect field data such as IGRAC, IAEA, and FAO have been initiated and will be agreed on during the inception phase of the project. To ensure the long-term hosting and maintenance of the compiled groundwater data, it could be provided to AMCOW to potentially feed into its Knowledge Hub, which covers a wider scope of water and sanitation data. Data could also be provided to the regional centers and feed into their data platforms such as the SADC Groundwater Information Portal (SADC-GIP). Long-term and sustainable options to host and maintain the project data within a regional institution will be explored early in the project (during year 1) and adequate arrangements for involvement of such institution will be identified. It is important to mention that all (non-sensitive) data collected will be made openly and freely available on public repositories such as ZENODO to facilitate knowledge transfer to and uptake by regional/national organizations. Results will inform Output 1.4.1 (GW assessment Framework) and guide Output 1.2.1 (Lesson-sharing).

Table 4: Selected data sources relevant to the pan-African groundwater assessment.

Category	Illustrative Source(s)
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Groundwater Availability and Demand	<p>? Water availability and demand estimations at high spatial resolution under current and future conditions from the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP) [https://www.isimip.org/].</p> <p>? Earth observations data such as groundwater recharge and water productivity: WAPOR portal</p> <p>? Earth observations data such as water storage and groundwater recharge (MacDonald et al., 2021; Scanlon et al., 2022).</p> <p>? Global Groundwater Information System (GGIS) and Africa Groundwater Portal of IGRAC provide access to map layers, documents, and well and monitoring data.</p> <p>? SADC groundwater information portal (SADC-GIP)</p> <p>? Africa Groundwater Atlas of BGS introduces the groundwater resources of 51 African countries.</p> <p>? Global Groundwater Monitoring Network (GGMN) (UNESCO-IGRAC)</p>
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Groundwater Quality and Risk	?	Global mapping of arsenic in groundwater* (Podgorski & Berg, 2020)
	?	Review of arsenic occurrence in Africa waters (Ahoul? et al., 2015)
	?	Mapping of fluoride in groundwater (Figure 11)* (Amini et al., 2008; Brunt et al., 2004)
	?	Groundwater vulnerability mapping of nitrate for Africa (Ouedraogo et al., 2016)
	?	Global pattern of nitrate storage in the vadose zone (Ascott et al., 2017)
	?	WHO/UNICEF JMP data on sanitation facilities and services (https://washdata.org/data)
	?	A global dataset of surface water and groundwater salinity measurements from 1980?to 2019 (Thorslund & van Vliet, 2020)
	?	A global overview of saline groundwater occurrence and genesis by IGRAC* (Van Weert et al., 2009)
	?	FAO data on fertilizer uses and manure reuse (https://www.fao.org/faostat/en/#data)
	?	Global Freshwater Quality Database and information system (GEMStat) with water quality data of ground and surface waters reported by countries and organizations (https://gemstat.org/data/)
	?	Other relevant data and information in IGRAC and GAP database, such as field measurement data, aquifer vulnerability mapping, UNICEF arsenic models.
	?	Additional data and information covered in the latest World Bank report by Ravenscroft and Lytton (2022), including assessment, monitoring, protection, remediation and mitigation measures for groundwater pollution.

*Note: *these datasets are part of the groundwater assessment platform (GAP, gapmaps.info) hosted by EAWAG. GAP also includes groundwater quality mapping (arsenic, fluoride, salinity) from IGRAC, part of which is cited in the latest World Bank report by Ravenscroft and Lytton (2022).*

●*Activity 2.1.1.2: Gender and social inclusion groundwater and livelihoods assessment in Africa (responsible: IWMI)*

A gender and social inclusion (GESI) groundwater and livelihoods assessment will be undertaken in the first quarter of the project implementation. This activity is planned to augment and expand the baseline information already compiled. Specific attention will be given to groundwater-related risks and opportunities in relation to vulnerable groups including women, youth and ethnic minorities. Lessons learned from the experience of SADC GMI in developing GESI will be used to support the continental assessment.

●*Activity 2.1.1.3: Pan-African assessment of groundwater-related risks and opportunities (responsible: IIASA)*

A conceptual framework for assessing groundwater-related risks and opportunities will be built based on advanced data processing techniques using the data inventory built in Activity 2.1.1.1 and any additional data that could be made available through existing model simulations. This framework will be used to identify areas in Africa that present groundwater-related risks (e.g., aquifer depletion, water stress, water pollution, ecosystem degradation) and opportunities (e.g., available water for irrigation expansion, suitable water quality for drinking water supply, areas of high biodiversity value) based on their current biophysical, socio-economic and governance features and evaluate how they may evolve with economic development, population growth, climate change, and the implementation of various groundwater management options under feasible combinations of the latest set of global climatic (Representative Concentration Pathways RCPs) and socio-economic (Shared Socioeconomic Pathways SSPs) scenarios. It is noted that while gender disaggregated data may not always be available, every effort will be made to include such data in the collection and assimilation of data. To communicate assessment results, this activity will develop dedicated visualization tools to support exploration of groundwater-related risks and opportunities by using advanced visualization techniques (e.g., Visual Data Mining, Visual Analytics). This assessment will provide a unique tool to develop data driven narratives of groundwater futures in Africa and facilitate discussion among policymakers, development partners and private sector actors on current and future groundwater risks and opportunities at country and pan-Africa scale, and support strategic planning and investments to improve groundwater management and planning towards enhancing water security and resilience across the continent.

Outcome 2.2: RECs, RBOs, MSs capacitated in groundwater assessment tools and approaches (responsible: IIASA)

Output 2.2.1: Joint learning and exchange on sustainably assessing quantity and efficiently approaching groundwater quality, and potential risks of groundwater (responsible: IIASA & IWMI & AMCOW)

It is critical that capacity is strengthened through the activities so that knowledge that is generated is absorbed and incorporated into decisions at the right levels. Equally, it is important that capacities of RECs, RBOs and MSs are sufficiently enhanced so that they do not simply absorb knowledge but gain the skills to produce it in the future. Accordingly, Component 2 will include capacity development activities in groundwater assessment and related priority areas. To support this end, joint learning, training, and exchange on sustainably assessing quantity and thoughtfully approaching groundwater quality, and potential risks of groundwater, as well as gender-related topics associated with groundwater, will be facilitated. Also, trainings will be organized around the usability of the pan-African assessment tool on groundwater-related risks and opportunities (Output 2.1.1) to inform strategic planning and investment priorities across scales. The overall ambition is to create an enabling environment that strengthens groundwater management capacities and supports ownership of the knowledge, tools, and frameworks developed among the key stakeholders from AMCOW and RBOs/RECs/MSs.

- *Activity 2.2.1.1: Developing and delivering training programs on groundwater management, including topics such as hydrogeology, monitoring, and regulation (responsible: IIASA & IWMI & AMCOW)*

Four technical training courses for local experts selected by AMCOW/RBOs/RECs will be carried out. We plan to follow a training-the-trainers approach to pass the knowledge and expertise on to the local experts, who may then become trainers themselves. These training courses will be complementary to those developed by AMCOW, with the support of BGR, AGW-Net and other partners on groundwater management.

1. **Training 1** (led by IIASA) on data processing and analysis and the relevant tools such as GIS and remote sensing, like WaPOR portal.
2. **Training 2** (led by IIASA) on introducing hydrological, hydrogeological and water quality modeling focusing on the basics of modeling, model setup and calibration.
3. **Training 3** (led by IIASA) advanced training on state-of-the-art groundwater modeling. To this end, the existing groundwater model of IIASA will be extended and updated with new information collected by the project to perform advanced computations on groundwater availability, groundwater demand, and management options under the latest climate and socio-economic scenarios in Africa. This training will also cover the usability of the pan-African assessment tool on groundwater-related risks and opportunities (output 2.1.1).
4. **Training 4** (led by IWMI) on groundwater monitoring, management, governance and regulations. This fourth training will also cover gender-responsive approaches into groundwater management, including gender mainstreaming in water policies.

All trainings will be accompanied by the distribution of manuals, protocols, and training materials among participants and relevant stakeholders, which could potentially be made available through AMCOW's Knowledge Hub. Training activities will be convened and coordinated by AMCOW and implemented by IIASA and IWMI. It is important to mention that all modeling codes and (non-sensitive) data used in the project will be made openly and freely available on public repositories such as GitHub and ZENODO to facilitate knowledge transfer to and uptake by local experts.

COMPONENT 3: Demonstrating benefit: Utilizing evidence-based planning to realize on-the-ground impacts in pilots

Operational Aspects of three case studies. Each of the three case studies was developed with a set of key stakeholders, and an identified client and counterpart (Table 5). Likewise, past and ongoing financed projects were identified to understand the context in which current activities are to be undertaken. Projected outcomes, as well as scale up potential were also identified.

Table 5: Case Studies

	Shire	Uganda	Mono
Client and Counterpart	Department of Water Resources, Malawi & ARA-Centro, Mozambique	Directorate of Water Resources Management, Ministry of Water and Environment (Uganda)	Mono Basin Authority

Key Stakeholders engaged in the Design	<ul style="list-style-type: none"> - Ministry of Water Resources (Malawi) - National Directorate of Water Resources Management (Mozambique) - The Groundwater Management Institute of the Southern African Development Community (SADC-GMI) 	<ul style="list-style-type: none"> - Directorate of Water Resources Management, Ministry of Water and Environment (Uganda). - The Intergovernmental Authority on Development (IGAD) - Nile Basin Initiative (NBI) 	<ul style="list-style-type: none"> - Ministry of Water and Village Hydraulics (Togo) - Ministry of Water and Mining (Benin) - The Sahara and Sahel Observatory (OSS)
Envisioned Outcomes	<ul style="list-style-type: none"> - Shared data platform, populated in ongoing way, that supports improved management - Creation of Malawi-MOZ transboundary GW Committee 	<ul style="list-style-type: none"> - Groundwater Diagnostic Analysis (GDA) - Groundwater Strategic Action Plan (SAP) - Support catchment plans in the Upper Nile Management Zone of Uganda 	<ul style="list-style-type: none"> - Shared data platform, populated in ongoing way, that supports improved management - Incorporation of GW into MBA planning
Past project finance	World Bank/CIWA through SADC-GMI	ADA, IWMDP, World Bank	GIZ
Innovation and scale up potential	Approaches can be scaled in basins without RBOs	Innovative framework to integrate groundwater into planning at national and basin level that can be scaled into other basins within and beyond Uganda	Approaches can be scaled with other RBOs in Africa

Outcome 3.1: Evidence-driven transboundary groundwater management in the Shire aquifer system (responsible: IWMI and Ministry of Water Resources (Malawi), National Directorate of Water Resources Management (Mozambique), and SADC-GMI)

Output 3.1.1: Gender, Indigenous Peoples presence and water assessment for the transboundary Shire aquifer system. (responsible: IWMI & AMCOW)

Activity 3.1.1.1: The team will evaluate the gender equality and presence of Indigenous Peoples implications related to groundwater management options and climate change in the Shire Aquifer System to achieve specific outcomes. This evaluation will play a significant role in advancing the objectives of the 'reach-benefit-empower' framework, which is aimed at promoting gender equality and social inclusion within the project. By ensuring the active participation of women, youth, and ethnic minorities in all knowledge exchange platforms as both contributors and recipients of knowledge and information, the project fosters an inclusive environment that deliberately addresses implicit and explicit gender hierarchies, power imbalances, and trust levels. Consequently, within the first six months of the project,

a comprehensive gender-sensitive water assessment will be carried out in the Shire aquifer system to gain a comprehensive understanding of gender roles and relationships, differentiated access to and control of water resources (especially groundwater), and gender-specific livelihood strategies. Attention will also be given to the concerns of ethnic minorities. This assessment will serve as a valuable opportunity for collaboration between countries and projects, particularly in the context of the Shire aquifer system. The specific activities will focus on conducting a gender-sensitive water assessment for the Transboundary Shire Aquifer system, as well as assessing the presence of Indigenous Peoples in the project area and subsequently developing an Indigenous Peoples Plan (IPP).

Output 3.1.2: Co-design of harmonized groundwater monitoring network, rehabilitation of non-functional wells and targeted new borehole drilling (responsible: IWMI, Ministry of Water Resources (Malawi), National Directorate of Water Resources Management (Mozambique) and SADC-GMI)

Coordinated monitoring of groundwater is a foundation for sustainable management of shared aquifers. Monitoring groundwater is fundamental to increasing our understanding of the groundwater system in a basin or aquifer (recharge, discharge, changes in quality and quantity over time), assessing the impact of climate variability and change as well as groundwater abstraction, and fostering sustainable management of the groundwater resources. It also supports drought response decisions and groundwater management activities, such as water allocation planning, investigation of surface-groundwater interactions, and determining the hydraulic characteristics of the groundwater system. Increasing water security in the face of increasing groundwater use, recurrent droughts, climate variability, and change has increased the need for understanding and managing groundwater resources in the Shire Aquifer System. However, the existing groundwater level-monitoring network is inadequate to enable proper groundwater resource assessment. There are only eight monitoring boreholes in the Malawi portion of the Shire River Basin (i.e., on average, one monitoring borehole for every 2840 km².) and no single observation well in the Mozambique portion of the basin, making it difficult to assess groundwater resources in the transboundary context properly. The lack of harmonized groundwater data in the two countries makes it difficult to manage groundwater resources sustainably. Therefore, the main objective of these activities is to design a harmonized groundwater level-monitoring network for the Shire transboundary aquifer to enable better characterization of the aquifer and resources assessment. After the necessary data is collected and the existing monitoring system is analysed and a hydro-census or field survey is conducted, a harmonized groundwater monitoring network will be co-developed with relevant stakeholders (Ministry of Water Resources (Malawi), National Directorate of Water Resources Management (Mozambique) and SADC-GMI). The groundwater monitoring network design for the Shire Aquifer will consist of five activities.

- *Activity 3.1.2.1:* Inventory of the existing monitoring network, establishing what is currently monitored, developing a team of experts, and determining the aims of monitoring. As a first step for groundwater monitoring network design for the Shire shared transboundary aquifer, a team of experts (approximately three people) from the two countries from the relevant organizations (Ministry of Water Resources (Malawi), National Directorate of Water Resources Management (Mozambique)) and one person from SADC-GMI will be selected. One focal person from each country will be assigned among the six teams of experts. The role of the focal persons includes: 1) serving as a main person for data collection from various offices, ii) closely working with the team

in co-designing a harmonized groundwater monitoring network, and iii) supporting field instrumentation. After identifying the focal persons, the next step is to hold a workshop of 7 people. The workshop aims to discuss baseline/ existing data in the Shire River Basin, identify data source/where the data is located, identify groundwater issues in the Shire River Basin, clarify the extent of the existing monitoring network, and select fit-for-purpose approach for the monitoring.

●*Activity 3.1.2.2:* will focus on collecting the necessary data (desktop study) and conducting hydro-census or field survey.

Relevant data and maps for the monitoring network design are collected from various offices with the help of the focal persons. Data on geology, hydrogeology, soil, land use, groundwater level, and hotspot zone/pollution sources will be collected. The purpose of the hydro-census/survey is to verify existing borehole conditions. This helps identify which observation borehole can be included in the primary groundwater monitoring network design. Hydro-census/survey include registering geographic coordinate, water level measurement, borehole elevation, casing height, borehole owner, land use in the vicinity of the borehole, sources of contamination or significant pumping in the vicinity (if any), and accessibility. The hydro census/survey results will guide the monitoring network design and the selection of observation boreholes for pilot instrumentation. The focal persons from the Ministry of Water Resources (Malawi), the National Directorate of Water Resources Management (Mozambique), and IWMI will conduct the hydro-census/ field survey jointly.

●*Activity 3.1.2.3:* will focus on co-designing an harmonized groundwater monitoring network (determining the number and location of monitoring wells).

After the necessary data is collected and analyzed and hydro-census is conducted, co-design of groundwater monitoring will be carried out by IWMI with the selected seven teams of experts from the Ministry of Water Resources (Malawi), National Directorate of Water Resources Management (Mozambique), and SADC-GMI. The new monitoring network will be developed by combining an existing network with the newly designed monitoring network. For the Shire, a primary groundwater monitoring network will be designed with additional monitoring wells at strategic monitoring locations (a secondary monitoring network designed to measure specific issues). Primary monitoring networks enable larger-scale groundwater assessment. Hence, monitoring wells are usually located at a relatively large distance but sufficiently close to provide an overall picture of the groundwater situation.

●*Activity 3.1.2.4:* will focus on determining prioritization and sequence for monitoring sites.

After the monitoring network is co-designed, the sequencing of the implementation of the monitoring network installation will be carried out by the same team of experts. Some of the criteria used for prioritization of the monitoring well location for drilling and rehabilitation will include monitoring of aquifer which has transboundary significance and should be productive (major aquifer), the monitoring wells should represent groundwater conditions over a substantial area of the aquifer, the monitoring well should be able to monitor specific areas where the aquifer may be more susceptible to water level related problems, and the selected monitoring well should provide information that aids in the assessment of groundwater-surface water interaction.

Output 3.1.3: Data logger installation in selected boreholes and analysis of measured data (responsible: Ministry of Water Resources (Malawi), National Directorate of Water Resources Management (Mozambique) SADC-GMI & IWMI)

To help identify existing observation boreholes that need rehabilitation to be included as part of the harmonized groundwater monitoring network, a hydro-census/survey will be conducted. In some instances, the existing monitoring boreholes may not be rehabilitated due to the extent of their damage or there may be a need to drill monitoring boreholes to get good spatial coverage. In the latter case, drilling of new boreholes may be warranted. Data logger installation will consist of six activities:

- *Activity 3.1.3.1:* Drilling 4 boreholes (2 per country). The newly drilled monitoring boreholes can also confirm aquifer yield potential. An experienced and competent hydrogeologist contractor will be subcontracted from each country to do the drilling and rehabilitation of existing non-functional monitoring boreholes and will be accompanied by well log characterization and pumping test.
- *Activity 3.1.3.2:* Rehabilitation of existing non-functional monitoring boreholes (five per country). In some instances, the existing monitoring boreholes may be damaged and need rehabilitation before installing a data logger for monitoring. After optimal monitoring well locations are identified, ten existing wells (five from each country) near-optimal well locations will be selected for and rehabilitated by an experienced and competent hydrogeologist contractor sub-contracted from each country.
- *Activity 3.1.3.3:* Installation of approximately 14 data loggers (4 newly drilled and ten rehabilitated boreholes). Data loggers provide more reliable and regular data to support decision-making. Data loggers will be installed to monitor groundwater level, temperature, and Electrical conductivity (EC) at user-specified timestep. EC is used as a proxy for salinity. Salinity is the main water quality limiting groundwater use in the Shire alluvial transboundary aquifer. Using a data logger allows measurements to be taken automatically and precisely at set intervals without manpower, saving time and money. It helps provide confidence in monitoring data and offers better monitoring data to stakeholders to build trust and cooperation between the two countries sharing the aquifer. More frequent data collection will allow better groundwater model calibration, confirm aquifer performance and response, and determine connectivity between aquifers and groundwater-dependent ecosystems.
- *Activity 3.1.3.4:* Capacity building events on data logger installation. The team involved in the co-design of the monitoring network and two practitioners involved in groundwater monitoring from the two countries will be trained (on-site and dedicated one-day training). The training components include data logger basics, installation, operation, maintenance of data loggers, and downloading data logger data and visualization.
- *Activity 3.1.3.5:* Analysis of newly obtained data to identify spatial and temporal trends in groundwater levels and reporting. Spatial and temporal analysis of monthly groundwater level data in 14 boreholes monitored over a 2-year period will be used to assess trends in groundwater level and EC. The spatial and temporal measured EC data will be used to infer hotspots in salinity and seasonal variability. IWMI will do the analysis, and the findings will be shared with stakeholders.

Output 3.1.4: Water quality monitoring and laboratory analysis (responsible: Ministry of Water Resources (Malawi), National Directorate of Water Resources Management (Mozambique) & IWMI)

Water quality challenges pose a growing risk to public health, food security, biodiversity, and other ecosystem services. The natural factors that affect water quality include water-rock interactions, rock types, weathering of rocks, and atmospheric deposition. The anthropogenic factors include point and non-point-source pollution. Monitoring groundwater quality is desirable, where changes in groundwater chemistry result from anthropogenic impacts. Therefore, identifying the main water quality issues and assessing their spatial and temporal variability is crucial for better management and sound decision-making related to water quality problems. Water quality monitoring and analysis will consist of three activities:

- *Activity 3.1.4.1:* Approximately 100 water samples from rivers, springs, boreholes, and wells will be collected twice (during the dry and wet seasons) for chemical and isotopic analyses. In situ water quality sampling will be done for electrical conductivity, pH, Dissolved oxygen, and temperature in the field during the sampling. The most common method of measuring in situ water quality is with a multi-parameter water quality instrument.

- *Activity 3.1.4.2:* Chemical analyses (anion, cation, nutrient, metal, and metalloid) and stable isotope analysis will be carried out at the International Atomic Energy Agency (IAEA) laboratory in Malawi. A total of around 100 samples will be collected from rivers, springs, boreholes, and wells for dry and wet seasons will be analyzed in the laboratory for HCO₃, NH₄, NO₃, NO₂, PO₄, F, Cl, and SO₄, and Be, B, Na, Ca, Mg, Al, P, K, V, Cr, Mn, Fe, CO, Ni, Cu, Zn, As, Se, Mo, Cd, Sn, Sb, Ba, Hg, Pb, and U. In addition, isotopic water quality analysis will be carried. Collaboration will be undertaken with the IAEA global water quality network for chemical and isotopic water quality analysis. IAEA has launched the Global Water Analysis Laboratory (GloWAL) Network to empower countries to generate their own chemical, biological, and isotopic water data. Malawi is one of the focal countries. The GloWAL Network enables collaboration and communication amongst laboratories to share knowledge, foster capacity building, and support training so that each laboratory can reach its full potential. IAEA is also currently doing groundwater dating in the Shire River basin to assess groundwater residence time. This data is useful to us in inferring the source of pollution and the sources of groundwater resources and interpreting the spatial and temporal water quality variability in the Shire River Basin. IAEA also has a wealth of experience in isotopic analysis, which is useful to us to collaborate with them.

- *Activity 3.1.4.3:* Data will then be analyzed, in particular regarding spatial and temporal variability of water quality parameters. Temporal and spatial variability in water quality can be caused by variations in the quantity and quality of recharge, changes in groundwater flow patterns, complex interactions between geology and groundwater, the spatial distribution of pollution sources, groundwater-surface water interactions, etc. Identifying the key physical processes and factors controlling these variabilities is key for sound decision-making. This analysis consists of three. Approaches: 1) assessing change in water quality by comparing the dry and wet season water quality laboratory results, 2) spatial analysis of water quality and identifying locations of impaired water quality, and 3) relating spatial variability in water quality to human and natural factors. This kind of assessment will be useful for policymakers and the public to understand the current water quality status in the transboundary aquifer and provide a basis for the effective development and management of groundwater and surface water resources.

Output 3.1.5: Shared data platform to support improved aquifer planning (responsible: IWMI)

Monitored data sharing and storage mechanisms are agreed upon, and all monitored data is shared. At the transboundary level, sharing information and data between countries is often difficult, especially when there is no agreement or protocol between the countries on data sharing and harmonization of data formats, frequency of data collection, etc. Regular data exchange between the two countries rarely occurs without a formally established framework for data exchange. Two key activities will be undertaken:

- *Activity 3.1.5.1: Data Exchange Protocol.* Modalities of data exchange will be agreed, including format of the data, parameters to be exchanged, and the frequency of the data sharing between Ministry of Water, Malawi and DNGRH, Mozambique. Four activities will be undertaken to achieve a transboundary water agreement specifying data exchange modalities. First, a joint declaration and assembling of a key expert team from the two countries will be undertaken. Second, two assessments will be undertaken to inform the formulation of the agreement that emerges from cross-country dialogues. Third, periodic dialogues will be implemented to foster convergence and, ultimately, agreement on the scope of data exchange.
- *Activity 3.1.5.2: Platform to house data.* A platform for the monitored data in common format, and the collected data will be agreed with countries and utilized to store data. Trainings will be implemented to ensure common approaches to database population.

Outcome 3.2: Groundwater integrated into catchment planning in Uganda (responsible: IIASA & MWE)

The main outcome expected to be achieved is enhancing technical and analytical capacities of the Directorate of Water Resources Management of the Uganda Ministry of Water and Environment (DWRM-MWE) to further integrate groundwater resources into catchment planning. Activities will focus on supporting the development of groundwater capacities and know-how to be integrated into the catchment plans of the Upper Nile Water Management Zone (UNWMZ). This area is an important groundwater hotspot in Uganda due to several critical factors, including: i) population growth and increasing water demands for different uses, ii) hosting some of the most important refugee settlements in the country, and iii) holding very high poverty levels. This outcome will be obtained through one main output.

Output 3.2.1 Tools and evidence base for managing and planning groundwater in the Upper Nile Water Management Zone (UNWMZ) of Uganda (responsible: IIASA & MWE)

- *Activity 3.2.1.1: Gender-sensitive water assessment in the Upper Nile Water Management Zone.* (responsible: IWMI, MWE, IIASA). Following the same rationale as described in activity 3.1.1 in the Shire aquifer system, within the first six months of the project, the team will carry out a comprehensive gender-sensitive water assessment in the UNWMZ to gain a good understanding of gender roles and relationships, differentiated access to and control of water resources (especially groundwater), and gender-specific livelihood strategies. Attention will also be given to the concerns of ethnic minorities. The knowledge gained through this assessment will be used to foster an inclusive environment that deliberately addresses (implicitly and explicitly) gender hierarchies,

power imbalances, and trust levels among groundwater stakeholders in the UNWMZ and during the execution of project activities in the pilot.

In terms of responsibilities, this activity is going to be coordinated by the MWE under the guidance of the gender expertise of IWMI and supported by IIASA.

•*Activity 3.2.1.2: Assessment and monitoring of groundwater resources* (responsible: IIASA & MWE). The MWE, through the DWRM is spearheading the preparation of catchment management plans to guide investments in management and development of water and related resources. Catchment Management Planning Guidelines following 5 different steps have been developed to guide the preparation of Catchment Management Plans. One of the steps in the guidelines is on water resources analysis where assessment of both groundwater and surface water resources is undertaken, and the results are integrated into water balance models. However, as reported by the MWE it has been noted that there are inadequacies in methodologies for assessing groundwater resources and integrating this information into water balance models. Thus, the quantity and role of groundwater resources in catchment water balance is poorly understood, resulting in gaps in water resources analysis.

This activity will focus on developing a groundwater resources assessment, including a quantification of the spatial-temporal dynamics of groundwater recharge and groundwater exploitation by different users, and assess the quantitative and qualitative status of groundwater bodies in the UNWMZ. The assessment effort will also look into future projections considering climatic and socio-economic change scenarios to identify future trends in groundwater availability and use. A modeling framework is already set up and calibrated in Uganda as part of the ongoing SWAQ-Uganda project led by IIASA and MWE, and will allow to update the current water balances of the two catchment plans in the UNWMZ (Aswa and Albert Nile), while also supporting the mapping of recharge and discharge areas, current water-table levels and groundwater quality, exploitation and recharge dynamics, and the identification of trends for main drivers for groundwater exploitation and recharge (e.g. land use change, wetland management, agricultural water use). Likewise, it will also provide insights into future projections of groundwater use and availability. To support the monitoring of the groundwater and improving the reliability of the modeling results, the project foresees the installation of data loggers in existing monitoring boreholes managed by MWE to support data collection and monitoring. To improve the spatial data coverage, there may be a need to drill additional monitoring boreholes. Drilling and rehabilitation of existing non-functional monitoring boreholes will be done by an experienced and competent hydrogeologist contractor.

In terms of responsibilities, the installation of the groundwater data loggers will be coordinated by the MWE. Monitoring data will be processed and prepared by the MWE and transferred to IIASA. The model set up, calibration and the development of the groundwater scenarios will be led by IIASA and supported by the MWE and a national consultant, who will participate in the data collection and model parametrization.

•*Activity 3.2.1.3: Develop a Groundwater Diagnostic Analysis (GDA) including assessment of related governance, socio-economic, legal, Indigenous Peoples and gender aspects* (responsible: MWE & IIASA).

The two catchment plans in place in the UNWMZ (the Albert Nile and the Aswa) were developed in 2016 and provide a fair diagnosis of the water resources situation in the catchments, main stakeholders and issues of significant importance, as well as an action plan. However, the status and prospects of groundwater resources management are insufficiently addressed in these plans.

This activity will focus on developing a Groundwater Diagnostic Analysis (GDA) building upon the science-based assessment of the current and future state of groundwater resources in the UNWMZ and its two catchment zones (Activity 3.2.2), but it will also address key aspects related to groundwater governance, socio-economic aspects of groundwater, Indigenous Peoples aspects and the role of gender in groundwater management (as per the results of activity 3.2.1). The GDA will include: i) the review of existing legislative and policy frameworks related to groundwater; ii) a detailed mapping of roles and responsibilities with regards to groundwater management and capacity needs, iii) an analysis of socio-economic outcomes related to groundwater use, with focus on poverty, ethnic minorities, and gender inequalities; and iv) the evaluation of existing and potential conflicts related to groundwater resources. This diagnosis is aligned with the Water Security Diagnostic Initiative of the World Bank, and IIASA team has large experience supporting the World Bank in implementing these frameworks in the Western Balkans and Central Asia region (<https://iiasa.ac.at/projects/world-bank-eca-regional-water-security-initiative-development-of-assessment-and>).

Several consultations and field visits are foreseen throughout the duration of this activity. A series of interviews and a field visit will be organized at the beginning of the project (Months 3-6) to support the identification of data gaps. Back-to-back, the team will organize a stakeholder workshop (Workshop I) to present the activity to the catchment stakeholders to define the scope of the assessment and get the buy-in (Month 3-6). Expert meetings and bi-lateral consultations are expected to be organized ad-hoc to support the data collection for the GDA. The preliminary results of the GDA will be presented in a second workshop (Workshop II) for refinement, validation and endorsement by the DWRM-MWE and other key stakeholders (Month 22-27). It is foreseen the participation of stakeholders at different institutional levels (catchment but also national level) to ensure that catchment planning of the UNWMZ but also national strategic goals are considered.

In terms of responsibilities, the GDA will be coordinated by MWE, with the support of IIASA and a national consultant. Field visits will be organized by the MWE. Interviews will be conducted by a local consultant in coordination with the MWE. The workshops will be designed by IIASA and its organization coordinated by the MWE and the national consultant. The MWE will play an important role in selecting, engaging and inviting the key stakeholders at national and local levels.

• *Activity 3.2.1.4: Development of a groundwater strategic action plan (SAP) to support the planning and management of groundwater resources at the catchment level (responsible: MWE & IIASA)*
The SAP will include several tasks: i) participatory elaboration of the shared vision for the sustainable development and management of groundwater, and ii) the identification and the mapping and prioritization of actions (policy, legal and institutional reforms, infrastructure investments) that will be deemed necessary to enhance the sustainable development of groundwater and/or reverse the degradation trends of groundwater bodies, and improve the overall sustainability in the UNWMZ. These strategic actions will aim to reduce groundwater extraction and/or increase groundwater

recharge in the areas most critical for unsustainable developments. Likewise, the SAP will also identify actions to support the socio-economic development strategies within the UNWRM building on a sustainable groundwater management strategy. Strategic actions will be formulated as specific investment needs with clearly articulated underpinning assumptions and a rationale for what biophysical and socioeconomic benefits are expected from these investments.

The approach to developing this SAP builds on the GEF LEARN manual for the development of the SAP and participatory visioning and action planning process developed in the GEF-ISWEL Project (GEF project ID 6993) and successfully applied by IIASA in the Zambezi and Indus basins (<https://www.iswel.org/>). This process will be completed in a series of two additional workshops and on the GDA results. First of this series of workshops (Workshop III) will help to define the shared vision, including the strategic goals and targets in a participatory manner with catchment and national stakeholders, along with the mapping and prioritization of groundwater actions for its further integration into catchment planning in the UNWMZ (Month 33-36). A final workshop (Workshop IV) will be organized to present the results of the SAP, explore financial support to carry out the action plan, and discuss the options for upscaling and transferring the proposed approach to other Water Management Zones and beyond Uganda in basin planning from other countries and regions (Month 43-45). To this end, a wide range of relevant stakeholders will be invited including (i.e., departments dealing with groundwater-related aspects within the MWE, other relevant ministerial lines such as economic affairs or irrigation, the World Bank, ADA, other development actors, ANBO, AMCOW, RECs, investors, NGOs).

In terms of responsibilities, the SAP will be coordinated by the MWE and supported by IIASA and a national consultant. The workshops will be designed by IIASA, and its organization coordinated by the MWE and the national consultant. The MWE will be responsible for selecting, engaging and inviting the key stakeholders at national and local levels.

Outcome 3.3: Supporting integrated aquifer management & reducing groundwater risks in the Shared Mono Basin (responsible: IWMI & Mono Basin Authority)

Output 3.3.1 Gender, Indigenous Peoples presence and Water Assessment for the shared Mono basin (responsible: IWMI & AMCOW).

● *Activity 3.3.1.1:* Following the same rationale described in activity 3.1.1, in the Shire aquifer system, during the first six months of the project, the team will conduct a gender, Indigenous Peoples presence and water assessment in the Mono River Basin to gain a clear understanding of the role of gender and gender roles and relations, gender-differentiated access to and control of water resources, in particular groundwater, and gender-differentiated livelihood strategies. The project aims to create an inclusive GESI environment whereby knowledge exchange can occur in a manner sensitive to implicit and explicit gender hierarchies, power imbalances, and levels of trust in the Mono River Basin. The project ensures that women, youth, and ethnic minorities are included at all levels of knowledge exchanges. Considerations to ethnic minorities will be included with an assessment of

presence of Indigenous Peoples in the project area and the development of an Indigenous Peoples Plan (IPP).

Output 3.3.2 Design of harmonized groundwater monitoring network and data loggers installed (responsible: IWMI & Mono Basin Authority)

The existing groundwater level monitoring network in the Mono River Basin is inadequate to enable proper groundwater resource assessment (stakeholder consultation). While there are few observation boreholes in the Dahomey coastal aquifer, groundwater in the hard rock aquifer covering the major portion of the Basin is largely unmonitored. Therefore, the main objective of this activity is to co-design a harmonized primary groundwater level monitoring network to obtain better spatial coverage. The improved groundwater monitoring network will be designed by optimally combining the existing network with additional boreholes. Primary groundwater level monitoring networks enable larger-scale groundwater system assessment. A harmonized primary groundwater monitoring network will be co-developed with relevant stakeholders. This activity will consist of seven sub-activities.

- *Activity 3.3.2.1:* will focus on assessing the existing monitoring network, establishing what is currently monitored, developing a team of experts, and determining the monitoring aims.

A team of experts (approximately three people) from the two countries from the relevant organizations (Ministry of Water and Mining, Benin, Ministry of Water and Village Hydraulics, Togo) and one person from MBA will be formed. One focal person from each country will be chosen from the team of experts to facilitate data collection, supporting fieldwork, and data logger installation with the IWMI team installation. At the beginning of the project, a workshop will be held among the seven experts and IWMI to discuss the data sources, groundwater issues in the basin, the extent of the existing monitoring network and to decide on the monitoring network design approaches. The selection of the experts from each country and MBA will be coordinated by the MBA.

- *Activity 3.3.2.2:* will focus on collecting the necessary data (desktop study) and conducting hydro-census/field survey. It is important that before the monitoring design is carried out, the necessary data related to geology, hydrogeology, land use, source of pollution, etc., should be collected and analyzed. The hydro-census/field survey aims to identify which existing observation boreholes can be included in the primary monitoring network design. The data collected during the hydro-census/field survey include observation of well locations, borehole condition, land use near the borehole, casing height, water level, etc. The necessary data will be collected with the help of the focal persons in each country.

- *Activity 3.3.2.3:* will focus on the co-design of harmonized groundwater monitoring network (determining the number and location of monitoring wells). The co-design of the groundwater monitoring network for the Mono River Basin will be done by IWMI and the seven teams of experts from the relevant organizations and MBA. The main aim of the harmonized groundwater monitoring network design is to identify the optimal monitoring borehole location that enables proper assessment of groundwater at the basin scale. Spatially distributed monitoring networks will be designed to provide data representative of the various topographic, geologic, and land-use environments.

●*Activity 3.3.2.4:* A fourth activity will focus on determining a prioritization and sequence for monitoring sites. To help identify existing observation boreholes that need rehabilitation to be included as part of the harmonized groundwater monitoring network a hydro-census/survey will be conducted. In some instances, the existing monitoring boreholes may not be rehabilitated due to the extent of their damage or there may be a need to drill monitoring boreholes to get good spatial coverage. In the latter case, drilling of new boreholes may be warranted. The newly drilled monitoring boreholes can also be used to confirm aquifer yield potential. Drilling and rehabilitation of existing non-functional monitoring boreholes will be done by an experienced and competent hydrogeologist contractor and will be accompanied by well log characterization and pumping test. One borehole per country will be drilled, and eight boreholes will be rehabilitated (4 per country).

●*Activity 3.3.2.5:* After optimal monitoring well, locations are identified in the co-design stage, approximately 10 existing boreholes that are near-optimal well locations will be selected and instrumented with a data logger. The data loggers monitor groundwater level, temperature, and electrical conductivity (EC) automatically and precisely at set intervals (time steps). EC will be used as a partial proxy for water quality. Data loggers provide more reliable and regular data to support decision-making.

●*Activity 3.3.2.6:* Conduct an analysis of spatial and temporal trends in groundwater level. Groundwater level, temperature, and EC data collected in 10 monitoring boreholes over a 2-year period will be analyzed for spatial and temporal variability. The key to understanding spatial and temporal variability is identifying key physical processes and factors of this variability (such as rainfall, geology, land use, etc.). This activity will be led by IWMI, and results will be shared with stakeholders

Output 3.3.3: Water quality monitoring and laboratory analysis (responsible: Mono Basin Authority & IWMI)

The Mono Basin is home to many cities' industries and agricultural activities and suffers from multiple sources of contaminants. Basin-level water quality monitoring is needed to understand the spatial distribution of these contaminants. Water quality sampling from boreholes, rivers, and springs distributed across the basin will be carried out during the dry and wet seasons to analyze water quality's spatial and temporal variability. The samples will be analyzed for nutrients, anions, and cations. The pH, TDS, EC, and DO will be measured in situ. Basin-wide water quality assessment is important to understand the spatial distribution of water quality issues and to identify spatially dispersed pollution sources. Our assessment aims to identify the main contaminants of concern in the Mono River Basin by conducting basin-wide water quality sampling and analysis. Identifying contaminants of concerns and sources helps the RIWE-Mono (OSS)/GEF 7 IUCN Mono Basin project to design pollution control measures at the source to reduce the concentration level or limit further water quality degradation (Annex F outlines broader complementarity between the two projects). Water quality monitoring and analysis will consist of three activities:

●*Activity 3.3.3.1:* Water samples from rivers, springs, boreholes, and wells will be collected for chemical and isotopic analyses. Water samples will be collected during the dry and wet seasons. In situ water quality sampling will be done for electrical conductivity, pH, Dissolved oxygen, and

temperature in the field during the sampling. This will be done on 80 sites twice during the project period (i.e., dry and wet seasons). The most common method of measuring in situ water quality is with a multi-parameter water quality instrument.

- *Activity 3.3.3.2:* Chemical analyses (anion, cation, nutrient, metal, and metalloid) and stable isotope analysis will be carried out at the selected laboratory. The results from this analysis will be useful for policymakers and the public to understand the current water quality status in the transboundary aquifer and provide a basis for the effective development and management of groundwater and surface water resources.

- *Activity 3.3.3.3:* Analysis of spatial and temporal variability of water quality parameters will be conducted and documented.

Output 3.3.4: Shared data platform to support improved aquifer planning (responsible: Mono Basin Authority & IWMI)

Monitored data is stored and shared in a common platform. The availability of adequate groundwater quantity and quality data is critical for aquifer management. However, data sharing between countries is often challenging at the transboundary level, and monitoring lacks transboundary harmonization. The lack of data-sharing agreements and formally established data exchange frameworks constrain regular data exchange between countries. Therefore, formulating and adopting a common data exchange framework in the Mono River Basin is essential to transboundary cooperation. Two activities will thus be undertaken:

- *Activity 3.3.4.1:* Data Exchange Protocol. Modalities of data exchange will be agreed, including format of the data, parameters to be exchanged, and the frequency of the data sharing between Ministry of Water and Mining (Benin) and Ministry of Water and Village Hydraulics (Togo). Four activities will be undertaken to achieve a transboundary water agreement specifying data exchange modalities. First, a joint declaration and assembling of a key expert team from the two countries will be undertaken. Second, two assessments will be undertaken to inform the formulation of the agreement that emerges from cross-country dialogues. Third, periodic dialogues will be implemented to foster convergence and, ultimately, agreement on the scope of data exchange.

- *Activity 3.3.4.2:* Platform to house data. A platform for the monitored data in common format, and the collected data will be agreed with countries and utilized to store data. Trainings will be implemented to ensure common approaches to database population.

Output 3.3.5 Strategic well rehabilitation to reduce flood risk to drinking water supplies (responsible: Mono Basin Authority & IWMI)

Given the flood risks in the Mono Basin, it is essential to identify wells at risk of contamination so that drinking water supplies are protected. As such, three activities will be undertaken.

- *Activity 3.3.5.1:* will center on a diagnostic to identify existing drinking water and sanitation infrastructure (borehole, small reservoirs, drinking water supply networks, piezometric network) under flood risks.

- *Activity 3.3.5.2:* At-risk infrastructure will then be the focus of the second activity, which will center on rehabilitation and protection of drinking water and sanitation infrastructure identified to be at flood risk (piezometric network). Approximately 10 sites will be rehabilitated in total.
- *Activity 3.3.5.3:* Finally, to ensure rehabilitated infrastructure is maintained, training of local stakeholders on maintenance of drinking water and sanitation infrastructure under flood risk will be implemented in the third activity. Effort here will be made to include women in particular as they are not only intimately impacted by sanitation infrastructure and the availability of water, they are also often the people in the household responsible for collecting and storage of water for household consumption.

Outcome 3.4: Decision-making on prioritization of groundwater investments enhanced (responsible: SADC-GMI & AMCOW)

Output 3.4.1 Knowledge exchange, study tours & communities of practice to support cross-pilot learning (responsible: SADC-GMI)

A knowledge exchange output aims to support information sharing and to foster continual learning among the three case studies- Shire, Uganda, and Mono- grounded in a community of practice that extends lessons globally. Activities include peer-to-peer learning among the five countries-Malawi, Mozambique, Uganda, Benin, and Togo. The other major purpose of this component is to facilitate knowledge sharing among the five implementing countries and other countries in Africa to scale up good practices. This can be done through study tours whereby practitioners or technical specialists from other African countries visit the pilot case studies to gain practical knowledge.

1. Communities of Practice Key personnel involved in the project implementation in the 3 case studies from the five countries will meet quarterly online to discuss implementation challenges and share lessons learned. This will facilitate peer-to-peer learning and identification of implementation issues and addressing them on time.
2. Study Tours to facilitate knowledge sharing across the case studies, two study tours are planned in this project. Approximately 20 participants are expected to participate in each study tour. This will be 3 participants from each implementing country (a total of 15) and 5 participants from Regional Economic Communities (e.g., IGAD, SADC, ECOWAS). The first study tour is envisioned to be to the Shire and the second will be to the Mono Basin.

Output 3.4.2 Synthesis and dissemination of lessons (responsible: SADC-GMI and AMCOW)

The synthesis and dissemination of lessons learned is a critical component of this project as it allows us to capture valuable insights and knowledge gained throughout the implementation process. By summarizing the project activities and outcomes, and comparing the findings of the three different case studies we will distill key lessons that will inform the future implementation of similar projects and enhance future decision-making processes and contribute to improved groundwater management. To ensure effective synthesis and widespread dissemination, we will focus on two key activities:

1. **Synthesis.** Developing project briefs and blogs that compare experiences e.g., strengths or weaknesses in the preparation, design, and implementation of the three pilot case studies, implementation challenges, groundwater level trends across the case studies, water quality issues, identified co-benefits from improved groundwater management (e.g., avoidance of local conflicts, socio-economic services provided by groundwater-dependent ecosystems), institutional frameworks in groundwater planning and management in the three case studies, and engagement with the private sector.
2. **Dissemination.** Channeling case study highlights (including briefs and blogs just mentioned) via social media platforms (e.g., LinkedIn, Twitter, TikTok, etc.) as well as on the project website, created as part of component 5.

COMPONENT 4: Long-term Vision and Capacity. (Lead: AMCOW & IWMI)

This component aims to facilitate a pan-continental gender-inclusive Youth Forum in Africa around G4DR: engaging youth in G4DR dialogues, mobilizing and building the capacity of youth to develop regionally and locally relevant communication and outreach strategies and interventions, including through digital innovations; supporting pancontinental networks to enable uptake of long-term workable and sustainable strategies and solutions

Outcome 4.1: Youth across Africa is capacitated on groundwater to enhance consideration of social and cross-sectoral dimensions of groundwater (responsible: IWMI & AMCOW)

Groundwater overuse and pollution will have inter-generational impacts, as decisions now can create risks or foreclose opportunities later. Indeed, the impacts of salinization or pollution, or depletion of an aquifer, are often irrevocable and as such can compromise possibilities available to future generations. Facilitating a pan-continental, gender-balanced Youth Forum in Africa around G4DR, enhancing the beyond-project capacity, outreach, networking, and uptake of long-term workable and sustainable strategies and solutions that support inter-generational equity. As young people are gifted with innovation, imagination, energy and optimism, they can play a vital role in ensuring SDGs are achieved. Also, they have the right and responsibility to build synergy for a new system of development founded on knowledge sharing, cooperating and the prioritization of issues such as water security.

Output 4.1.1: Youth Forum for G4DR ? creating opportunities for youth of all genders and social differences i) for learning and interaction with professionals and decision makers active in groundwater; and ii) putting forward their voice in decision making processes. (responsible: IWMI & AMCOW)

Key to creating and ensuring a sustainable legacy for the outcomes and learning from this project is to involve young women and men at the core of new thinking and learning regarding the future of groundwater and how this supports a water secure Africa. The project will facilitate a forum for young African professionals and practitioners in the groundwater and CCA fields, enabling a step-change in focus and engagement in groundwater and climate change across Africa. It will encourage cross-learning and co-development of knowledge in this cross-field and aim to get groundwater on the action agenda

for climate change action, considering its key role in inter-generational resilience, sustainability, health, food security, etc.

In order to achieve these goals, the project will leverage networks and partnerships that the project team has already established. For example, IWMI, through its Transformative Futures for Water Security Initiative, has already worked closely with the World Youth Parliament for Water and the Young Water Professionals to ensure that the Youth and youth interests are represented in the eight missions that have been developed as part of IWMI response to the recent UN Water Conference outcomes. In addition, the project team has established a good working relationship with AMCOW's Youth Focal point. AMCOW is currently in the process of launching a 'youth structure' which is in essence a coordination mechanism to facilitate the implementation of Africa's Youth and Gender Inclusion (YoGI) Strategy. This coordination mechanism includes a technical expert committee (TEC) who provides strategic oversight, and constitutes 10 partner representatives within the thematic area of gender, social inclusion and youth. Additionally, there are 110 AMCOW Knowledge Officers who were appointed by the Member States and who serve as National Coordinators on youth and gender activities liaising with the youth and gender network and or individuals at country level. Finally, AMCOW has already put together a database with detailed contact information of over 700 youth and gender individuals who are currently subscribed to the AMCOW youth and gender processes at country level. There are three activities that have been developed in support of Output 4.1.1:

- *Activity 4.1.1.1:* will seek to establish **water domain youth networking channels** and nodes of collaboration that will guide and support the Forum. Specific attention to be given to channels and nodes within the case study countries. For this activity, the teams already established networks and partner organizations such as AMCOW will be essential.
- *Activity 4.1.1.2:* creates an opportunity to host and facilitate collaborative workshops/meetings with representatives of various youth forums (identified in the first activity) linked to water. The main purpose here will be a **Youth Forum Action** plan that includes the forming of a core planning group and leadership team. The Action Plan will be updated during the four-year period into an Implementation Plan that will lay the groundwork for the sustainability of the Forum.
- *Activity 4.1.1.3:* will both guide and support the Forum to **establish entry points** at project and country level as well as pan-continental entry points in other groundwater projects, initiatives and decision-making processes that will provide opportunities to elevate youth concerns and viewpoints. Again, established networks, platforms or hubs, and partner organizations will be essential in the successful achievement of this activity.

Outcome 4.2: Website or social media platform by the Youth Forum, attracting youth to the debate and building knowledge sharing around the importance of youth in taking an active role in G4DR in Africa, and continue driving the agenda forward (responsible: IWMI)

Output 4.2.1 builds on the activities and of Output 4.1.1 by providing opportunity and support in reaching out to a wider community. There are two main activities under Output 4.2.1.

- *Activity 4.2.1.1:* A first activity will **establish youth outreach ambassadors** for the G4DR project as a part of the Forum. The main task of the youth outreach ambassadors is to utilize social media

in communicating the learning and opportunities emanating from the project and networks being created through the project.

- *Activity 4.2.1.2:* A second activity will support the Youth Forum and the Youth Ambassadors in establishing a **social media presence** by creating content, exploring and implementing various opportunities such as: podcasts; blogs; tiktok; Instagram, Twitter etc. related to G4DR and other groundwater related news.

COMPONENT 5: Knowledge management and M&E: Supporting capture, exchange and dissemination of key project advancements, as well as evaluation of project progress relative to targets (Lead: IWMI)

Outcome 5.1: Knowledge management & dissemination to support visibility and adoption (responsible: IWMI & AMCOW)

The final component of the project will focus on adaptive results-based management and sharing of information and lessons learned. The project will develop an approach to knowledge management and a strategy for communication, which will be sensitive to the proposed outcomes of the 'reach-benefit-empower' gender mainstreaming framework. This will update and strengthen the ongoing communication efforts of AMCOW, including modernizing the existing website into a Pan-African hub for information sharing to support wide dissemination of good practices, lessons-learned and outputs achieved by the G4DR on the management of the continent's groundwater resources and provision of water supply services. Project findings and lessons at pan-African, sub-regional and national level will make use of the AMCOW-led Africa Water Week, the SADC GMI annual groundwater meetings, and other existing regional efforts that the IWMI supported PMU can facilitate to strengthen as well as to the GEF IW:LEARN initiative. Knowledge management will involve multi-directional sharing of lessons among AMCOW and regional centers that aim to harness synergies, which can accelerate and amplify positive impacts on water security on the ground.

Output 5.1.1: Programme findings and lessons learned identified and contribute to IW:LEARN. (responsible: IWMI)

This output will consist of two key activities.

- *Activity 5.1.1.1:* will center on creation and regular updating of a project website.
- *Activity 5.1.1.2:* will center on participation, learning and knowledge exchange at GEF IW Learn bi-annual conferences. Likewise, project partner will seek for collaboration with UNESCO IHP who is coordinating a few activities with Component 4 of the IWLearn 5 project (*Deliver Support to Surface Freshwater, Groundwater, and Marine Ecosystem Subsets in Support of Portfolio Strategic Priorities*) that are closely linked to the focus of G4DR. One is connected to the organization of dialogues to promote conjunctive management of surface and groundwater within GEF projects, and a second one, related to enhance capacities of GEF projects dealing with groundwater governance.

Output 5.1.2: Information sharing mechanism & communication strategy developed enabling broad access to best practices and lessons learned in the countries supporting AMCOW (responsible: IWMI)

While IW:LEARN will provide a global platform to exchange, AMCOW will leverage existing channels in Africa to disseminate information and share groundwater knowledge. This output will encompass two activities.

- *Activity 5.1.2.1:* A **first activity** will center on developing a communications strategy that harnesses existing networks in Africa, which can be used to disseminate information on project progress. through AMCOW an additional knowledge exchange platform focused on Africa-wide knowledge management. Relevant national agencies, in particular lead partners in the five target countries will be invited to contribute to all knowledge sharing events.
- *Activity 5.1.2.2:* A **second activity** will focus on implementation of the communication strategy by plugging into water events in Africa, to promote the G4DR project.

Outcome 5.2: Adaptive results-based management and sharing of information and lessons learned (responsible: IWMI)

Output 5.2.1: Gender-responsive monitoring system operating and providing systematic and regular information updates on progress towards reaching G4DR targets (responsible: IWMI)

- *Activity 5.2.1.1:* centers on development of a gender-responsive monitoring system?that is, a system that monitors all activities but with sex-disaggregated data and information collection. The gender-responsive M&E system will feed into the overall knowledge management and monitoring and evaluation processes of the project. Emphasis of the gender responsive M&E system will be on using data disaggregated by sex, age and ethnicity, and gender-responsive indicators. The idea behind including this aspect to the M&E part of this project is to assist in keeping track of all gender-related activities and assess progress in gender and minority inclusion. All project activities, progress and reports will be reviewed to ensure that gender and minority considerations are included. The gender responsive M&E system will be informed by the ?reach-benefit-empower? framework, and appropriate ?gender-checks? will be developed to facilitate the evaluation.
- *Activity 5.2.1.2:* centers on updating, and communicating results, of the M&E System. Ultimately, M&E will be one of the key functions provided by the project PMU, under the guidance of FAO in its role of GEF Implementing Agency. This effort will aim at the evaluation of the progresses made by the project. In this context, an important task for the PMU will be to work with partners and countries to periodically review the project indicators to ensure they are fully up to date and aligned with regional agreements, and to national policies and project targets. Consequently, the establishment of aforementioned project monitoring system for G4DR targets is critical for effective project management. The monitoring system will be presented to Steering Committee and adjusted based on their feedback.

6) Alignment with GEF focal area and/or Impact Program strategies

The project aligns with IW-3-6: Enhance water security in freshwater ecosystems through enhanced regional and national cooperation on shared freshwater surface and groundwater basins.

Within the GEF-7 International Waters Focal Area Strategy, the proposed project aligns with Objective 3, 'Enhance water security in freshwater ecosystems'. Under this, the project aligns with the three areas of strategic action: 1) advance information exchange and early warning; 2) enhance regional and national cooperation on shared freshwater surface and groundwater basins; and 3) invest in water, food, energy and environmental security, as follows:

- G4DR is designed to enhance the availability of sound data and information about groundwater quantity and quality through coordinated data monitoring, processing, and sharing at multiple scales in Africa (continental, transboundary and national) as well as through targeted capacity building activities (addressed by Components 1, 2, 3 and 5). This will enable predicting future 'hotspots' and 'basins at risk' at continental scale and build the science base for informed prioritization of policies and investments in the pilots.
- G4DR is designed to improve groundwater-related policy and governance by explicitly incorporating groundwater into planning processes and strengthening the connection between the different continental, regional, national and sub-national planning and management bodies (AMCOW, RECs, RBOs and MSs), for transboundary aquifers. Strengthening AMCOW as a central node for groundwater planning at a pan-African level is a strategic approach that will lead to long-term resilience gains across Africa as institutional improvements will facilitate upscaling of effective and cooperative solutions (addressed by Components 1, 3 and 4).
- G4DR is designed to introduce an effective cross-sector coordination into groundwater related planning processes through the proposed pan-African assessment of groundwater-related risks and opportunities, stakeholder engagement activities at multiple levels and case study modeling (e.g., the Uganda pilot), which all consider the water-food-ecosystem nexus. The project will also institutionalize improved cross-sector deliberations through AMCOW providing guidance on national and transboundary planning processes (addressed by Components 1, 2, 3, 4 and 5). Ultimately, these multi-sector and cross-scale coordination will ensure improving concurrently water, food and ecosystem security across Africa.

7) Incremental/additional cost reasoning and expected contributions from the baseline, the GEFTF, LDCF, SCCF, and co-financing

Scenario in which the project is not implemented. Under business-as-usual conditions, the AMCOW groundwater desk would likely not be sustained. AMCOW would lose a key platform to assert the role of groundwater in water security and resilience across Africa. Equally, the hub-and-spoke framework through which AMCOW links with regional groundwater hubs would remain undeveloped. Evidence on groundwater in Africa would not receive an infusion of resources to support advances that support improved roll-out of solutions. Pilots manifesting practical benefits of groundwater management around the continent would not be widely undertaken. And youth would not receive support to learn about the processes and benefits of groundwater management.

Scenario in which the project is implemented. The project provides a platform for supporting resilience and water security at the pan-African level, with relatively few financial resources. Hence, from this, it is clear that: 1) The project may lay a critical foundation for the proposed institutional support framework of continental collaboration around groundwater, and 2) Further achieving the full benefits of the project's activities and ensuring long-term beneficial development outcomes depend on clear strategies for parallel as well as long-term engagement and investments at multiple levels, and continuous capacity development and priority setting, hopefully building on the clear rationale and momentum built as part of the project. There is increasing focus on groundwater as a key component of resilience, water security and cooperation strategies and plans for Africa, with donors like the World Bank/CIWA, FAO, BGR, and the CGIAR, besides GEF, increasingly coming into this fold. Hence, there is a good chance of boosting the financial resource base in the field, while also coordinating and building synergy. The project purposefully aims to make the necessary linkages, create larger communities of practice, and drive the agenda forward. The following institutions and donors have been addressed and expressed interest in collaboration with the project and potentially providing co-financing for the full project: World Bank/CIWA, BGR, and the CGIAR.

Benefits of pan African GEF approach. Groundwater solutions can be promoted at national levels across Africa and provide significant benefits. Nonetheless, the cumulative benefits of pursuing groundwater-based solutions at an African level are presumed to be greater than independent pursuit of similar aims at national levels. The benefits achieved through a pan-African approach, over and above those derived from purely national approaches, are three-fold. First, a continental approach supports cross-region exchange which can catalyze greater impact. Second, economies of scale can be achieved by focusing on a wider area than just national level; for example, assessment of risks and opportunities related to groundwater can be undertaken at a continental level while also supporting country-level decision-making. Third, the legitimacy and networks of regional institutes can be leveraged to catalyze change across the continent, fostering incremental changes in many countries rather than just one.

8) Global environmental benefits (GEFTF) and/or adaptation benefits (LDCF/SCCF)

Future trends including climate change, population growth, urbanization, income growth and related demands on resources (water, energy and land) are expected to threaten water security needed to sustain healthy and viable ecosystems and human societies, and exacerbating vulnerability to shocks worldwide. As one of the most vulnerable and populous continents, Africa is the hotspot for risks and long-term negative impacts of global changes on water resources and the region that would benefit the most from incremental and efficient water-related investments and coordinated informed approaches across sectors and countries. Moreover, due to telecoupling through processes such as international trade and migration, other regions of the world would also benefit from a more water secure and resilient Africa.

G4DR focuses on the important role that groundwater could play for enhancing water security and resilience in Africa, and primarily aims to strengthen the capacity of AMCOW, being the central node for strategic planning and collaboration at a pan-African level, and incorporate groundwater into planning processes at multiple levels (continental, regional, transboundary, national). To do so, G4DR will deliver knowledge products, capacity building and assessment tools and approaches toward the community of practice for resilient groundwater management. Related, G4DR will create opportunities for youth of all

genders and social differences for learning and networking with professional and decision makers in the water-related sectors through the Youth Forum to raise awareness and attention to groundwater as part of the solution space for enhancing water security and resilience in Africa.

The expected outcomes of G4DR will promote an integrated approach to enhance resilience in Africa with sustainable groundwater development and management. They will also enable to identify priority areas for investments and policy developments across Africa, create opportunities for knowledge and technology transfers, and capacitate youth involvement into decision making processes related to investments and policies that will impact their future. These activities ensure the environmental benefits are delivered in the long term, well beyond the project lifetime. In shared aquifers, G4DR will help identifying opportunities for cooperation among countries in managing groundwater and help regional decision-makers to identify mutually-beneficial strategies for optimizing the use of transboundary groundwater resources. In particular, the project will identify potential conflicts among countries sharing aquifers due to limited data availability and sharing, provide strategic advice for mitigating these conflicts supported by AMCOW, and highlight mutually beneficial strategies for enhancing regional groundwater management. G4DR will also contribute to knowledge sharing through IW: Learn by participating in IW conferences. Equally important to dissemination will be interactions with international and regional institutions such as RBOs, RECs, WB, AfDB, WWE, and IUCN.

From a global perspective, the improved development and management of groundwater in the African continent would be of global importance due to several reasons. First, it will reduce the vulnerability of communities and productive activities to seasonal variations and climate shocks, which could contribute to reducing poverty and improving livelihoods and consequently avoiding conflicts among groundwater users and limiting labor migration. Second, Africa is home to significant freshwater resources that could enable, with adequate technology and know-how, sustainably increasing global food production. Moreover, improved groundwater management is expected to also have positive impacts on groundwater-dependent ecosystems such as wetlands, oases and springs, which provide key socio-economic services to local populations in Africa supporting their livelihood, including food, drinking water, habitat for valuable species, flood control, water quality improvement, waste disposal, and recreational opportunities. Lastly, Africa hosts large areas of global importance for biodiversity and has a significant carbon sink potential. Improving groundwater management and related groundwater-dependent ecosystems in Africa would make substantial contributions to meeting the ambitious global biodiversity conservation and climate mitigation targets. All these benefits can help accelerate the achievement of the Sustainable Development Goals, locally, regionally and at the global level.

9) Innovativeness, sustainability, potential for scaling up and capacity development

G4DR aims to support AMCOW, improve the knowledge base, build capacity, involve key international, regional and national stakeholders, and engage with youth of all genders and social differences (Components 1 and 4). The project's interventions are consistent with AMCOW's objectives to support RECs, RBOs and MSs to achieve water security and enhance resilience and with water sectoral priorities of pilot countries. These aim to guarantee the ownership of the project's achievements and outcomes by the stakeholders, and, together with knowledge sharing and capacity building, enhance the continental,

regional and local ability to preserve, to sustain and to replicate the project achievements later on and/or in other areas.

Component 1 of the project will support AMCOW as the central node for strategic planning at a pan-African level, which will considerably facilitate innovativeness and sustainability by providing a platform for discussion, collaboration, and knowledge sharing among stakeholders from different sectors and countries. Groundwater is a critical resource for many African countries, and its sustainable development and management is essential for economic growth, food security, and poverty reduction. However, groundwater planning in Africa is often fragmented and poorly coordinated, resulting in inefficient use and degradation of the resource. AMCOW when strengthened could address this challenge by bringing together stakeholders from different sectors and countries to develop a shared vision and strategy for sustainable groundwater management. AMCOW could also facilitate the development and dissemination of innovative approaches, technologies, and practices for groundwater management (e.g., use of renewable energy for pumping, water conservation measures, nature-based solutions, conjunctive management of surface and ground waters), drawing on experiences from different regions and countries.

Component 2 of the project will enhance the knowledge base to advance the development of cross-sectoral strategies, considering the important role of sustainable groundwater management for achieving water security through securing more reliable water supply to support the growing water demand of households, agriculture and industries, supporting the health of humans and ecosystems, and increasing resilience to climate change as well as other shocks. Capacity development is a crucial activity in G4DR so that knowledge that is generated in the project is absorbed and incorporated into decisions at the right levels. Moreover, it is important that capacities of local experts are sufficiently enhanced so that they do not simply absorb knowledge, but gain the skills to produce it in the future. Component 2 includes several capacity building activities in groundwater assessment, monitoring and prioritization of management interventions, following a train-the-train approach so that the knowledge and expertise are transferred to the local experts, who may then become trainers themselves.

The pilot activities in **Component 3** will address priority issues of the selected case studies and are designed taking into consideration some key criteria, including innovation, replicability and scalability. These activities, which will initially be carried out on a national and transboundary scale, can be replicated and scaled up in a later process. They will also demonstrate best practices for stakeholder engagement, monitoring and modeling of groundwater. Lessons learned from pilots will be codified and disseminated to further promote the potential for replication. Similarly, the achievements and lessons learned from the project implementation may be useful for future interventions in other regions.

Component 4 will engage youth in G4DR dialogues. Engaging youth in Africa in the context of groundwater management can have several benefits, including encouraging innovation. Youth in Africa represents a large and growing population, with over 60% of the population under the age of 25 in some countries (UNICEF, 2018). In addition to promoting innovation, engaging youth in groundwater management and sustainable development can also lead to increased community participation and ownership of water resources. This can help to ensure the long-term sustainability of groundwater resources and promote equitable access to water.

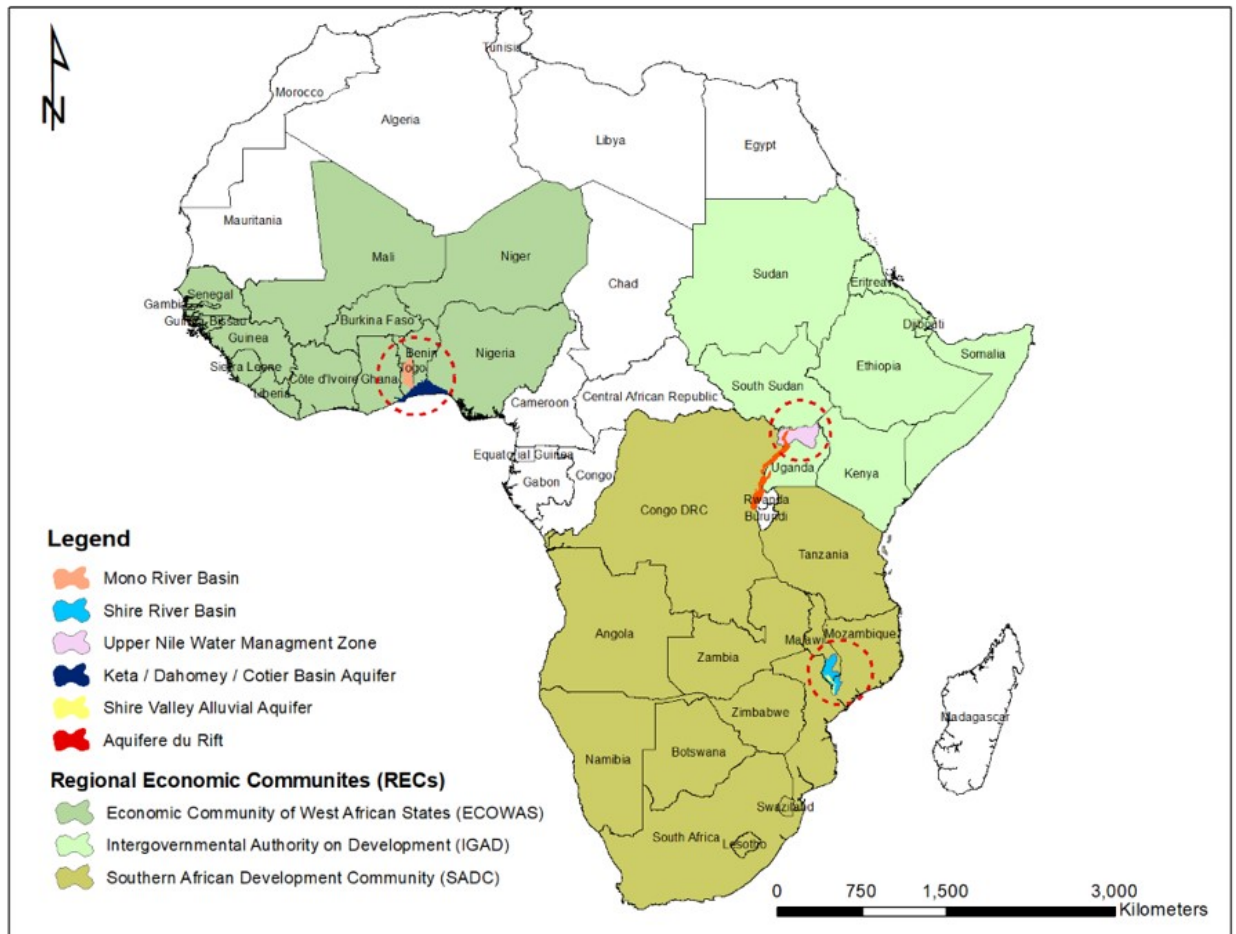
10) Summary of changes in alignment with the project design with the original PIF

Several changes have been effected to the design of the ProDoc, as compared with the PIF:

- Addition of third pilot. The most significant change in the project if compared with the design presented in the PIF is the addition of the Mono River basin aquifer (shared by Benin and Togo) as a third pilot. A third pilot was added in response to a GEF SEC request.
- Reformulation of component 3. Component 3 Outcomes and Outputs were modified to reflect the reality that all three pilots are now identified. Outcomes 3.1-3.3 each match with one pilot: 3.1 is focused on the Shire, 3.2 is focused on Uganda, and 3.3 is focused on the Mono. Outcome 3.4 is largely consistent with Outcome 3.2 in the PIF, which centers on exchange of experience and looking forward toward additional investment.
- Editorial changes to title and objective statement. At the request of GEF SEC, certain language was modified including 'deep resilience' and 'adaptation planning'. Language changes reflect better alignment with the project activities, are more generally accessible and easily translatable.
- Minor redistribution of component budgets. As activities were defined, it became apparent that a minor reallocation of budget across components would be beneficial. As such, a minor adaptation was made.

1b. Project Map and Coordinates

Please provide geo-referenced information and map where the project interventions will take place.



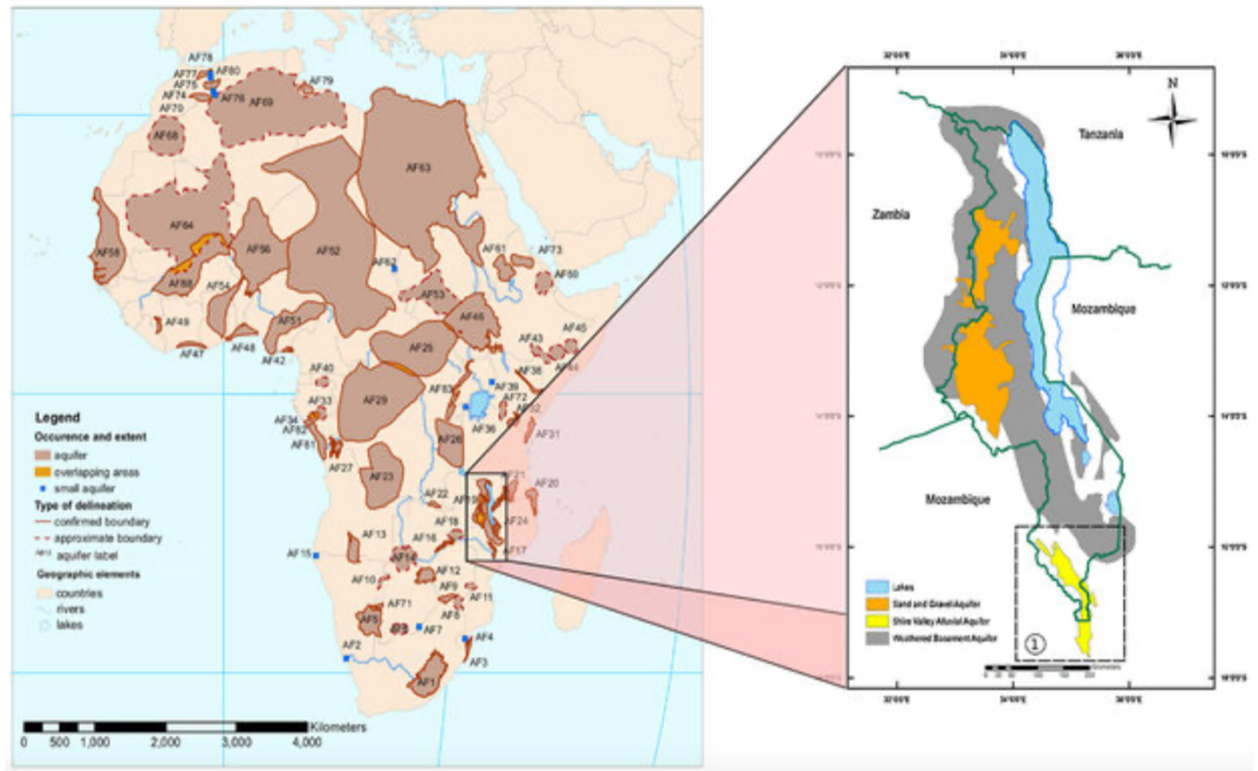


Figure 11: Map of the African continent illustrating the current known transboundary aquifers highlighting current identified transboundary aquifers of Malawi shared with surrounding countries (modified from IGRAC, 2015b). Source: Fraser, C., Kalin, R., Rivett, M., Nkhata, M., & Kanjaye, M. (2018). A national approach to systematic transboundary aquifer assessment and conceptualization at relevant scales: A Malawi case study. *Journal of Hydrology: Regional Studies*, 20.

<https://doi.org/10.1016/j.ejrh.2018.04.001>

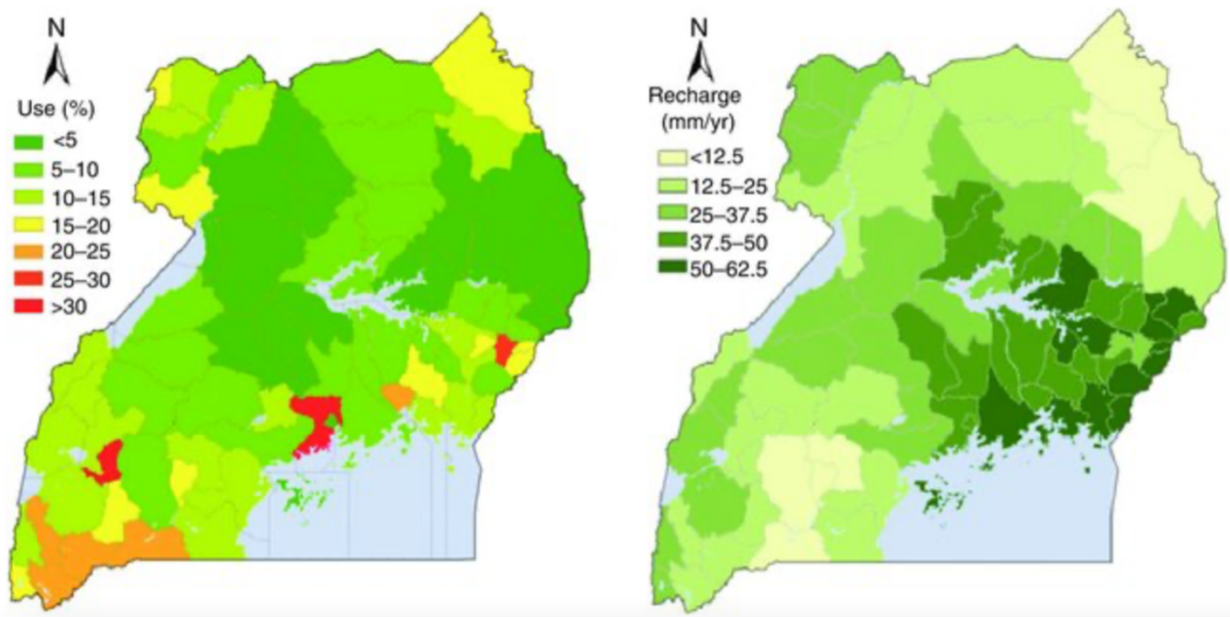
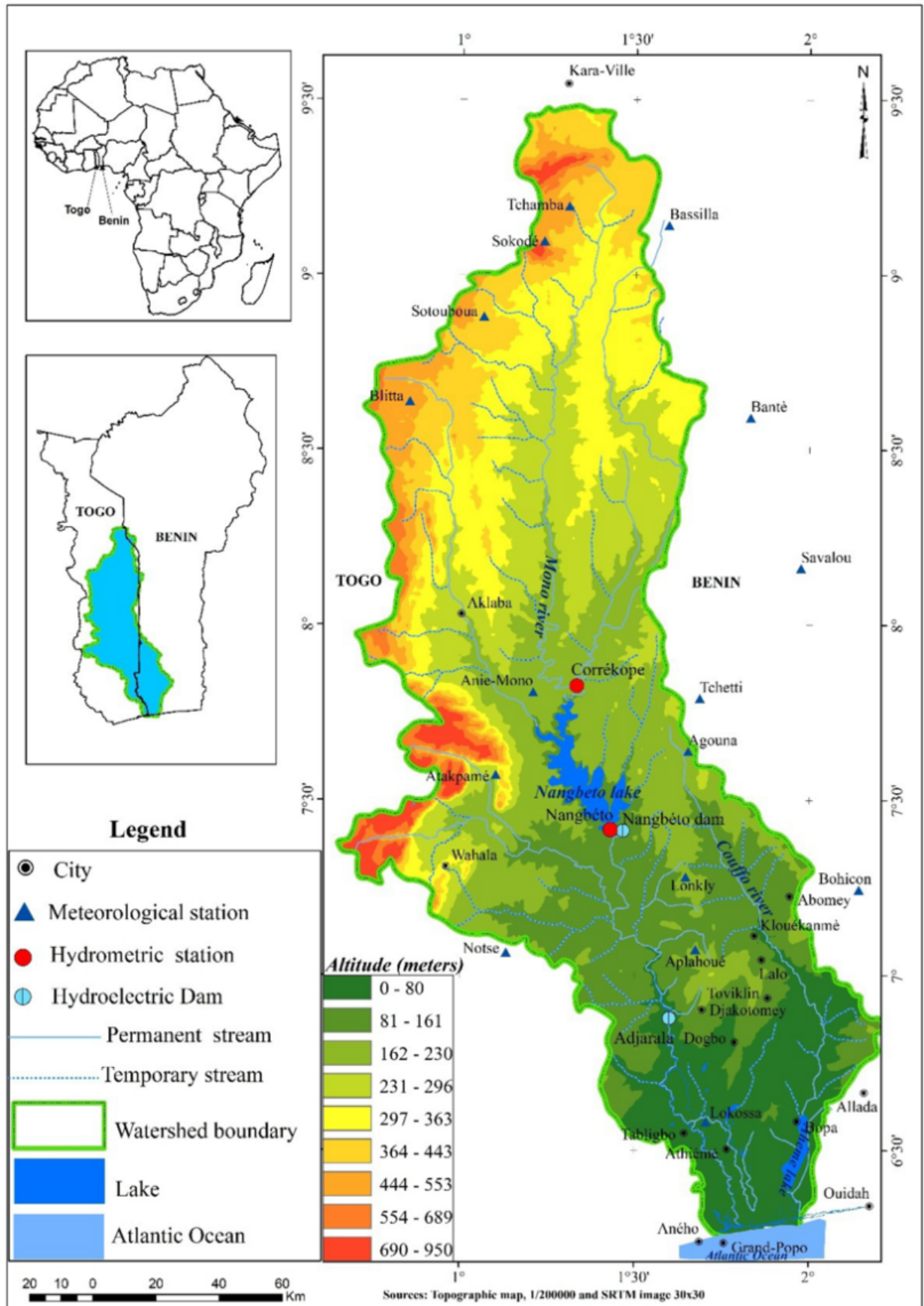


Figure 12: Map of Uganda showing groundwater use levels (left) and groundwater recharge levels (right). Source: Nayebare, S., Wilson, L., Carpenter, D., & Dziewulski, D. (2014). A review of potable water accessibility and sustainability issues in developing countries?Case study of Uganda. Reviews on Environmental Health, 0. <https://doi.org/10.1515/reveh-2013-0019>



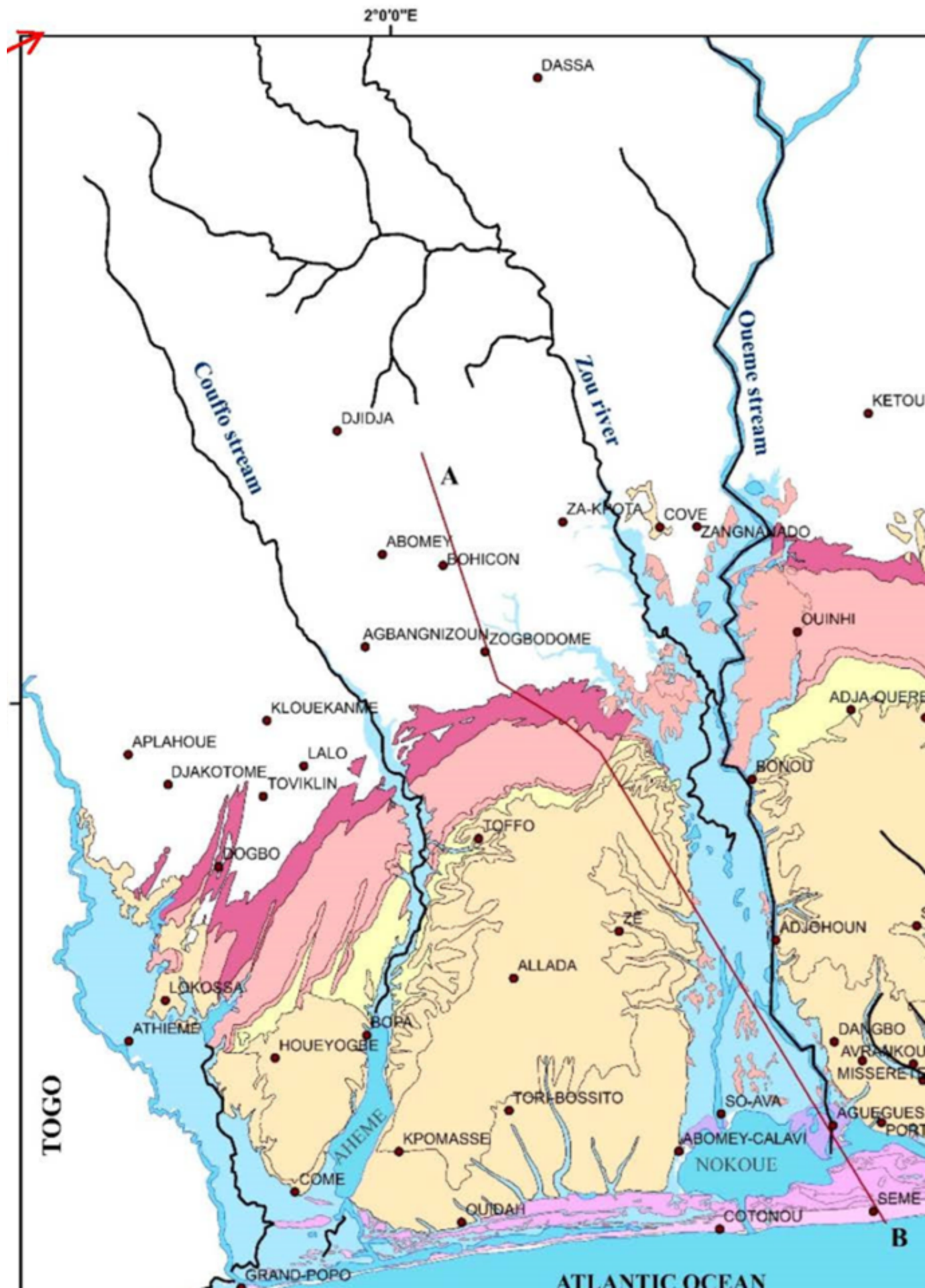


Figure 13a and b: Map of the Mono River basin between Benin and Togo and its Altitude levels (left) and a focus map of the coastal aquifer and its geological formations (right). Sources: Amoussou, E.; Awoye, H.; Totin Vodounon, H.S.; Obahoundje, S.; Camberlin, P.; Diedhiou, A.; Kouadio, K.; Mah?, G.; Hound?nou, C.; Boko, M. Climate and Extreme Rainfall Events in the Mono River Basin (West Africa): Investigating Future Changes with Regional Climate Models. Water 2020, 12, 833. <https://doi.org/10.3390/w12030833>; Agossou, A.; Yang, J.-S.; Lee, J.-B. Evaluation of Potential Seawater Intrusion in the Coastal Aquifers System of Benin and Effect of Countermeasures Considering Future Sea Level Rise. Water 2022, 14, 4001. <https://doi.org/10.3390/w14244001>

Case study	Longitude	Longitude
Mono River Basin	6.279167° N to 9.337853° N	0.687500° E to 1.937853° E
Dahomey Transboundary Aquifer inside Mono River Basin	6.279167° N to 7.045833° N	1.400000° E to 1.937853° E
Upper Nile Water Management Zone, Uganda	2.024471° N to 4.112376° N	30.740766° E to 34.279167° E
Aquifere du Rift Transboundary Aquifer inside the Upper Nile Water Management Zone, Uganda	2.200000° N to 3.592413° N	31.138841° E to 32.126363° E
Shire River Basin	- 17.695833° S to - 14.350000° S	34.245833° E to 35.950000° E
Shire Alluvial Transboundary Aquifer	- 17.669856° S to - 15.906579° S	34.403120° E to 35.493481° E

Map of Case Studies Geological layers are obtained from BGS. Abbreviations used in the legend represent dominantly fractured flow (F), dominantly intergranular flow (I), and mixed flow (IF)

1c. Child Project?

If this is a child project under a program, describe how the components contribute to the overall program impact.

N/A

2. Stakeholders

Select the stakeholders that have participated in consultations during the project identification phase:

Civil Society Organizations Yes

Indigenous Peoples and Local Communities Yes

Private Sector Entities Yes

If none of the above, please explain why:

Please provide the Stakeholder Engagement Plan or equivalent assessment.

During the Project Preparation phase, stakeholder interaction has been extensive. Building on early engagement with in-country partners in the development of the Project Information Form (PIF), an inception workshop was held on 9 March 2023 that outlined the G4DR concept as outlined in the PIF, sought feedback, and elaborated the plan for the project preparation phase. Participating in this event were more than 25 people from AMCOW, FAO, IWMI, IIASA, as well as from agencies in the concerned countries (Benin, Malawi, Mozambique, Togo, Uganda) and the Southern African Development Community-Groundwater Management Institute (SADC-GMI). The inception workshop was critical to foster convergence on the aims of G4DR, and to begin the process of more specifically outlining the program of activities to be pursued.

Following the inception workshop, intensive engagement with key partners was implemented. Outlines in more detail in Annex I2, multiple rounds of stakeholder engagement were held with partners in each case study to elaborate the priority set of activities that allow G4DR aims to be realized. Ultimately, engagement culminated in a face-to-face validation workshop, held 17 May 2023 in Addis Ababa. Verbal and written feedback was provided on the ProDoc, and certain key revisions were made such as i) stipulation that technical committees will be formed in each case study, coordinated by a national consultant, and ii) the addition of the Mono Basin Authority to the project steering committee. Ultimately, stakeholders expressed endorsement for the plan of activities and desire to see the project reach implementation.

Table 5. List of key stakeholders and their engagement during the project preparation and execution.

Institution	Description	Role during the project preparation/execution phase
African Minister's Council on Water (AMCOW)	<p>As the apex body on water, the African Ministers' Council on Water's (AMCOW)'s mission is to promote cooperation, security, social and economic development, and poverty alleviation among the Member States through the effective management of the African continent's water resources and the provision of water supply and sanitation services. AMCOW is mandated to provide political leadership in implementing the African Water Vision 2025 and water components of the African Union's (AU) agenda 2063. AMCOW is an inter-governmental Pan-African organization and a delivery mechanism on water and sanitation for the Specialized Technical Committee on Agriculture, Rural Development, Blue Economy and Sustainable Environment (ARBE) of the AU.</p>	Key partner for the project development. High-level engagement, facilitation, coordination, uptake, dissemination, and strengthening of MSs and regional entities in Africa related to the project objectives.
African Union Member States (AU MSs) and their line ministries and national sector departments and authorities tasked with environment, water resources, agriculture, water supply and sanitation, health, and climate change adaptation	The 55 African States in Africa, all AU members with varying degrees of capacity and frameworks for groundwater management and climate change adaptation.	Knowledge generators, uptake partners, next users, and disseminators of the policy and practice tools and guidelines co-developed as part of the project.
Regional Economic Communities (RECs) in Africa	Well-established multi-country cooperation mechanisms for securing regional integration and peace and stability across regions of Africa with similarities in cultural/linguistic, environmental, socio-economic, and political background.	Knowledge generators, uptake partners, next users, and disseminators of the policy and practice tools and guidelines co-developed as part of the project ? focusing on the transboundary freshwater cooperation challenges and opportunities, impacts of climate change and imperatives for transboundary cooperation on climate change adaptation.

River Basin Organizations (RBOs) in Africa	Formalized regional entities overseeing, supporting and guiding cooperation on freshwater in internationally shared river and lake basins.	Knowledge generators, uptake partners, next users, and disseminators of the policy and practice tools and guidelines co-developed as part of the project ? focusing on the transboundary freshwater cooperation challenges and opportunities, impacts of climate change and imperatives for transboundary cooperation on climate change adaptation.
Regional Centers of Excellence (CoEs) on freshwater, transboundary cooperation, groundwater, and climate change, e.g. CoEs under the African Union Development Agency (AUDA-Nepad) such as IGAD, ECOWAS and the Southern African Development Community	<p>These centers have the following core functions:</p> <p>Establishing a knowledge-driven link to MSs to better understand their national priorities and align these with strategies in Agenda 2063</p> <p>Strengthening of effective delivery mechanisms to implement AU continental programmes through projects on the ground</p> <p>Creating knowledge nodes and platforms for research</p> <p>Harnessing the partnership ecosystem to bring in expertise and best practices for implementation</p> <p>Disseminating knowledge such as best practices and proof of concepts</p>	Central knowledge partners for co-generation, uptake and dissemination of knowledge and policy products generated as part of the project. Also, an entry point for access to candidates for the Youth Forum on G4DR.
Africa Groundwater Network (AGW-Net)	An independent network of groundwater specialists in Africa, focusing on capacity development, information sharing and advocacy, networking and strengthening partnerships around sustainable evidence-based groundwater development and management in Africa.	Seedbed for recruiting members of the Youth Forum on G4DR as well as a dissemination channel for policy and capacity development material derived from the project.
The International Waters Learning Exchange and Resource Network (IW:LEARN) of the Global Environment Facility (GEF)	The IW:LEARN project was established to strengthen transboundary water management around the globe by collecting and sharing best practices, lessons learned, and innovative solutions to common problems across the GEF International Waters portfolio. It promotes learning among project managers, country officials, implementing agencies, and other partners.	Outlet for knowledge, knowledge products and lessons generated as part of the project.

BGR, and World Bank/CIWA	These are funding agencies that can facilitate strategic input to and collaboration on project implementation.	Organizations will sit on partners forum and be key to sustainable finance efforts
UNESCO, IGRAC & others	These are technical agencies that can facilitate strategic input to and collaboration on project implementation.	Organizations to be involved in partners forum.

A detailed matrix on Stakeholder Engagement during the project development and PPG phase can be found in Annex L. Stakeholder Engagement Matrix and Grievance Redress Mechanism.

In addition, provide a summary on how stakeholders will be consulted in project execution, the means and timing of engagement, how information will be disseminated, and an explanation of any resource requirements throughout the project/program cycle to ensure proper and meaningful stakeholder engagement

The project's stakeholders and beneficiaries will support identifying pathways to ensure the focus on vulnerable communities and contexts, and civil society and community-based organizations to engage as part of strategic planning for implementing policies and priority solutions identified during the project. Private sector entities have been approached in the full project preparation phase. Several key partners have been involved in write-up of this proposal. In particular, write-up of this PIF was led by IWMI, IIASA, AMCOW and FAO. AMCOW provided ongoing input to the formulation of objectives, outcomes, and outputs as well as guidance on selection of case studies. In addition, regional centers (SADC-GMI, OSS, IGAD), development financiers like World Bank and BGR, and the governments of Benin, Malawi, Mozambique, Togo and Uganda contributed valuable insights. The development of this PIF was ultimately a collaborative effort involving more than 10 key institutes who will collaborate in project preparation and implementation.

The program's key partner and beneficiary is AMCOW, and by implication the African regional organizations (RECs and RBOs) and the Member States and their constituencies. The program will draft national and international experts and organizations to provide contributions to key parts of the program as relevant. The Groundwater for aDvancing Resilience (G4DR) in Africa Project builds strongly on IWMI engagement with AMCOW in supporting the definition, institutional setup and implementation of APAGroP in its first phase 2019-2022. The program will allow APAGroP to capitalize on previous engagement and outcomes and help strengthen it beyond the first phase, particularly helping to consolidate and enhance the mandates of AU and AMCOW in groundwater and climate change adaptation.

Select what role civil society will play in the project:

Consulted only; Yes

Member of Advisory Body; Contractor;

Co-financier;

Member of project steering committee or equivalent decision-making body;

Executor or co-executor;

Other (Please explain)

3. Gender Equality and Women's Empowerment

Provide the gender analysis or equivalent socio-economic assesment.

The project will be aligned with the GEFs and FAOs Policies on Gender Equality, the FAO Regional Gender Strategy and Action Plan 2017-2019 for Asia and the Pacific, and the GEF Gender Implementation Strategy. The project is also in line with SDG 5 on Gender Equality, and the empowerment of women and girls, and it will therefore put efforts to improve the participation of women in decision-making, particularly in drought and flood management, water quality monitoring, and in the design and implementation of effective transboundary institutions.

Role of women in water management in Africa: Marginalized women and youth (female and male) bear disproportionate burdens of inadequate water resources, water quality degradation, inadequate WASH services and water-borne diseases, as they are the primary water collectors (Asaba et al., 2017). Women are also typically responsible for caring for family members who fall sick from waterborne diseases. AMCOW (2018) recognizes that this situation can be reversed by engaging women, girls, youth and other marginalized groups in water resources management and governance. However, in almost all rural communities in Africa, women do play key roles in providing, managing, and safeguarding water resources, and make significant contributions to domestic and productive water use. However, there are few strategic gains for women and their contributions are barely acknowledged - their labor, time investments and participation often under-valued, their voices only occasionally heard in community water governance and management, and their everyday experiences of water insecurity rarely informing water infrastructure design, management, and governance. The reasons for these persisting inequalities are multiple and complex. Women's relative lack of 'access to resources (land, water and finances)' is important, but these material inequalities are shaped by deep-rooted 'social roles, norms, values and cultural identities' (Rao et. al. 2017; 14). While working to reduce these inequalities, the focus in engaging women, increasing their access to and ownership of water, land, economic resources will need to be complemented by addressing structural and systemic biases. Otherwise, engaging women in water resources management can simply add to women work burdens, without any strategic gains for women. These tensions and contradictions are rarely reflected in the informal and formal institutional and governance arrangements for water management (Singh, 2017).

Gender-transformative groundwater management. Sustainable and equitable groundwater use can play a critical role in achieving multiple human development objectives including poverty eradication, human dignity and well-being, by providing water for domestic use, enabling food production and sustaining critical ecosystem functions (Moench 2003). In other words, groundwater has the potential to significantly improve the livelihoods of women, youth, and other marginalized social groups (Nigussie et al 2018). However, especially in situations of emerging contestations over water resources in climate challenged contexts, inequality in access to groundwater resources is shaped by entrenched power hierarchies which determine groundwater management policies, strategies, and instruments (Hoogesteger & Wester, 2015). A key outcome for this project can be in unpacking the implications of these challenges for different social groups such as women and youth, and in rethinking environmental stewardship and groundwater governance and management through an informed and transformative engagement of women, youth and marginalized groups (Nigussie et al. 2018).

Barriers to inclusivity. Participation of women in groundwater management remains low due to the factors, discussed above. Contextual cultural and social constraints limit the ability of marginalized women to speak in public, impact women's agency; and their low literacy levels are often equated with a lack of knowledge, even though poor and marginalized women reliant on hard to access groundwater resources ? might have a lot of experiential knowledge. Women's poor representation and presence in water institutions is one key barrier, even though in relative terms, participation of women in the domestic WASH sector is more prominent, while involvement in irrigation and other productive sector tend to remain male-dominated.

G4DR's approach to gender inclusion. Sustainable and equitable groundwater management calls for enabling changes in women's improved access to, and increased ownership of land and water resources; and enhancing their financial, technical capacities and abilities. But these interventions will not sustain if the social norms that reinforce gender and intergenerational inequality persist. Achieving this requires working together with women and men, engaging men and boys and encouraging positive shifts in gender relations, and change in values, beliefs and practices of local communities and other relevant institutions. Gender and social inclusion is a core goal of this project, and project activities will be guided by IWMI's gender-and-inclusion-strategy-2020-2023.pdf, which emphasizes a gender transformative approach. G4DR will consider the following approaches:

- Assess how climate change impacts availability and access to groundwater resources to most vulnerable groups such as resource-poor people, women and youth in terms of basic water security and livelihoods, using capabilities and vulnerabilities assessment tools.
- Provide gender-transformative recommendations on key action areas to i) access to and use of groundwater, ii) decision making and groundwater governance, and iii) pathways to change and influence social norms, cultural values and water roles and responsibilities.

Gender considerations will cross-cut project components We will apply a gender transformative framework to map key systemic and structural barriers to more inclusive interventions. By engaging with AMCOW, RECs, R/LBOs ? we plan to also build Gender Equality and Social Inclusion (GESI) capacity of multiple stakeholders. We will adopt a key focus on youth inclusion, by engaging with the Youth Forum to identify and pilot incentives and role models for youth, including females to become part of networks involved in groundwater for advancing resilience in Africa.

References

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- ? Singh, N. M., Ballard, K., & Lederer, M. (2017). Institutional arrangements for managing water resources in India: a review. *Environmental Science & Policy*, 75, 71-80.

Does the project expect to include any gender-responsive measures to address gender gaps or promote gender equality and women empowerment?

Yes

Closing gender gaps in access to and control over natural resources; Yes

Improving women's participation and decision making Yes

Generating socio-economic benefits or services or women Yes

Does the project's results framework or logical framework include gender-sensitive indicators?

Yes

4. Private sector engagement

Elaborate on the private sector's engagement in the project, if any.

A diverse set of actors from the private sector are important for planning and management of groundwater resources, encompassing well drillers, pump manufacturers/suppliers, consultants, groundwater-abstracting industries, water sellers and others. These actors are often overlooked in many groundwater initiatives. There are clear risks to businesses from groundwater depletion and pollution which has already been evidenced in some agricultural and urban areas across Africa. The private sector would benefit greatly from sustainable groundwater use, noting that they are ultimately accountable to the consumer base and other interests they represent. G4DR will seek to work closely with diverse private sector actors at the pan-African level and across pilot areas in supporting efforts to advance water security and resilience. During the project implementation, major groundwater users (e.g., agriculture, mining, water supply utilities) and relevant product and service providers throughout the groundwater value chains will be identified and benchmark criteria will be developed and applied to rank actors most suitable for engagement. The planned partners forum (Component 1) and stakeholders' engagement workshops (Components 1 and 3) will be used to interact and engage with those actors in understanding their perceptions and needs, and in drawing cross-learnings with other stakeholder from the collective knowledge, resources and networks. Links will also be made with other proposed activities like capacity building (Component 2) and the Youth Forum (Components 4) to improve groundwater-related knowledge and capacity of private sector actors. The project's engagement with private sector will be guided by sustainable and equitable principles, and will involve meaningful participation and consultation with local communities and other stakeholders, see also Stakeholder Engagement Matrix and ethics statement (Annex I2). Engagement activities with the private sector will be documented in the lessons synthesized in Component 3.

At the pan-African level, AMCOW will help facilitate engagement with the private sector, building upon their demonstrated capacity in this area, through for example, the AfricaSan dialogues associated with the WASH sector. AMCOW can also be instrumental in helping to call upon the private sector to prioritize investments in groundwater to advance resilience through climate-resilient infrastructure and inclusive water and sanitation services.

There are several private sector actors that can be relevant for improving groundwater management in the Shire aquifer. Some potential actors include:

- Water drilling companies: Private water drilling companies can provide the necessary expertise and equipment to drill boreholes and wells for groundwater extraction.
- Irrigation companies: Private irrigation companies can provide the necessary expertise and equipment to develop and maintain irrigation systems for agriculture that are based on groundwater sources.
- Pump manufacturers and distributors: Private companies that manufacture and distribute pumps can provide the necessary equipment to extract groundwater from wells and boreholes.
- Water treatment companies: Private water treatment companies can provide the necessary expertise and equipment to treat and purify groundwater for domestic and industrial use.
- Consulting firms: Private consulting firms can provide technical and management expertise for groundwater management and governance.

- Financial institutions: Private financial institutions can provide the necessary financing for groundwater management projects, such as borehole drilling and infrastructure development.

Groundwater management in Uganda can be significantly improved with the involvement of the private sector through Public-Private Partnerships (PPPs). Several private sector actors can play a significant role in improving groundwater management in Uganda. Some potential actors include:

- Water User Associations (WUAs): Water User Associations can be instrumental in improving groundwater management by engaging with the private sector for investment and by mobilizing communities to participate in water management activities. By promoting efficient water use and water conservation practices, they can contribute to better groundwater management.
- Local private companies: There are several private companies in Uganda that are involved in the water sector, such as water drilling and borehole construction companies. These companies can play a crucial role in providing technical expertise and support for groundwater management activities.
- Large-scale irrigation companies: Uganda has significant potential for large-scale irrigation schemes, which can be managed by the private sector through PPPs. These companies can help in the development and management of groundwater resources, providing new economic opportunities for farmers and promoting sustainable water use practices.
- Non-governmental organizations (NGOs): Several NGOs in Uganda are involved in water management and conservation. By partnering with the private sector, they can help in capacity building, awareness raising, and project implementation, thereby contributing to better groundwater management.
- International water management companies: International companies with expertise in water management and conservation can bring their knowledge and experience to Uganda, providing technical and financial support to improve groundwater management.

There are various private sector actors that can be relevant for improving groundwater management in the Mono River basin. Here are some examples:

- Private drilling companies: Private drilling companies can provide technical expertise and equipment for drilling and maintaining wells and boreholes, which are important for accessing groundwater in the basin.
- Water users' associations (WUAs): WUAs are organizations of water users that can play a key role in managing groundwater resources in the basin. Private sector actors can work with WUAs to provide technical assistance and training in water management, and to support the development of sustainable water use practices.
- Bottled water companies: Bottled water companies can be important stakeholders in groundwater management, as they rely on access to reliable sources of high-quality groundwater for their products. These companies can work with local communities and governments to promote sustainable water management practices that protect groundwater resources.
- Agricultural input suppliers: The agricultural sector is a major user of groundwater in the Mono River basin, and private sector actors that supply agricultural inputs (such as fertilizers and pesticides) can play a role in promoting sustainable water use practices among farmers. They can provide training on water-efficient irrigation techniques and promote the use of drought-resistant crops.

- Sanitation companies: Proper sanitation and wastewater management are critical for protecting groundwater quality in the basin. Private sector actors that provide sanitation services can work with local communities and governments to promote safe sanitation practices that minimize the risk of groundwater contamination.

5. Risks to Achieving Project Objectives

Elaborate on indicated risks, including climate change, potential social and environmental risks that might prevent the project objectives from being achieved, and, if possible, the proposed measures that address these risks at the time of project implementation.(table format acceptable):

Risk	Risk rating without mitigation	Mitigation measures	Risk rating with mitigation
Social/Economic/Environmental risk			
Climate variability and change: climate change is expected to have significant impacts on water resources and water-related sectors in Africa.	High	<ul style="list-style-type: none"> - G4DR addresses climate risk and climate change impacts on regional development by aiming to highlight the important role groundwater could play to increase resilience to climate shocks. - G4DR will incorporate a wide range of the latest climate projections for Africa in the pan-African (Component 2) and case study assessments (Component 3) to understand the impact of climate variability and change on the availability of and demand for groundwater resources, with the aim to inform the design of adequate adaptation measures to address climate impacts. - We plan to obtain the latest climate data from: (i) common historical meteorological forcing datasets (such as WATer and global CHange (WATCH) Forcing Data); (ii) bias-corrected climate-input data provided within the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP), based on CMIP6 climate model data); and (iii) high-resolution regional climate model data (e.g., from Coordinated Downscaling Experiment CORDEX). Future spatially-explicit climate change impacts under different scenarios will be simulated using hydrological modeling. Project partners IIASA and IWMI have a lot of experience on assessing climate risk. 	Low

Risks related to COVID-19 or any other pandemic:	Low	<ul style="list-style-type: none"> - Potential impacts of COVID-19 will be closely and regularly monitored throughout the project lifetime. - COVID-19 mitigation strategies and measures will be in line with policies, procedures and guidelines of the partner agencies, relevant countries and lessons learnt through execution of other projects in Africa since early 2020. 	Low
a) Delays due to COVID-19 or any other pandemic lead to slow implementation or stalling of the project	Low	<ul style="list-style-type: none"> - It is anticipated that, even if face-to-face interactions are reduced, the project will still be able to carry out most activities as planned with adaptive management and remote communication channels (e.g., email, online meetings, phone calls), which have been widely exercised in 2020-2021. - The project partners are prepared to invest in staff safety and remote working capacities (e.g., provide internet access, dongles, etc., to enable out-of-office work). 	Low
b) Delays due to COVID-19 or any other pandemic lead to slow or stalling of the local activities including stakeholder engagement process and capacity development activities that involve local and international mobilities	Medium	<ul style="list-style-type: none"> - In case of reduced mobility, the project will, as part of Components 1, 2, 3 and 4, assess and strengthen tools for remotely engaging actors and support remote project co-design tools for national and local stakeholders. This will ensure that the project delivers the anticipated co-design process and outcomes, and provide learning experience for local stakeholders. - The budget for in-person engagement process can be reallocated to engage a more diverse group of stakeholders, which strengthens local and regional ownership and increases long-term sustainability of project impact. 	Low
c) Impacts from COVID-19 affect the availability of technical expertise and capacity.	Low	<ul style="list-style-type: none"> - It is not currently anticipated that the COVID-19 restrictions would affect the availability of national expertise. Concerning international experts, it is expected that expertise will be provided remotely in case of COVID-19 restrictions. 	Low
d) Increased national debt/fiscal crises due to costs of COVID-19 responses influencing sustainability of project results where Government funding is needed.	Low	<ul style="list-style-type: none"> - G4DR focuses on governance, evidence-bases, long term strategic planning and investment plans. These aspects rely less on short-term reduction of government spending and therefore the risk is considered low. - Component 3 covers enhancing the prioritization and optimization of investment for G4DR. This shall enhance evidence-based planning for on-the-ground investment, which goes beyond government financing and includes the private sectors and public and private partnerships for investment. 	Low
e) Future risks of similar crises (including from human-livestock-wildlife interaction)	Low	<ul style="list-style-type: none"> - The project will ensure implementation of the One Health approach, contributing to a coordinated approach in promoting public health, animal health, plant health and environmental outcomes, including the human-livestock-wildlife interface. 	Low
Technical and coordination risks			

Capacity and information constraints: regions, where case studies are conducted may have information and capacity constraints, such as security risks and political instability. Moreover, the time spent with regional stakeholders may be too limited to fully understand and incorporate political and historical realities.	Medium	<ul style="list-style-type: none"> - Case study regions have been carefully selected to limit these risks in the project. The international project partners have previously collaborated with the national partners. They also have a good knowledge of data availability and data sources in the different case studies. - The project proposes to collaborate with the regional partners (SADC-GMI, IGAD, OSS) and various development partners (FAO, UNESCO, IAEA, IGRAC, BGR, BGS, the World Bank, etc.) already active within the case study regions, which should mitigate some of this risk. 	Low
Limited ownership and interest of partners: ownership and interest of countries, and/or private sector partners is limited in the development of policy documents (e.g., guidelines, framework and strategy).	Medium	<ul style="list-style-type: none"> - The policy guidelines and other policy documents will be co-developed with multisectoral actors. AMCOW as a key project partner will gauge and enhance the interest and ownership at both regional and national level. National focal point at AMCOW and national partners for pilots will be actively consulted throughout the project to ensure that the development of policy guidelines addresses existing policy gaps in line with regional and national policy frameworks. Many of the activities in the project are led/co-led by AMCOW and the national partners. - Private sector actors will be identified and mapped with context-specific engagement plans and development of commercially sustainable models, which will incentivize the engagement and take-up of the private sector. - Knowledge products and sharing will help to engage the public and the youth in driving policy changes and incentivize private sector engagement. 	Low
Limited uptake of project outcomes: national and subnational uptake of project outcome is limited due to the low-capacity environment.	Medium	<ul style="list-style-type: none"> - Learning and capacitation are planned as part of Component 2 to enable knowledge application and ownership by the right stakeholders from AMCOW, RBOs/RECs and MSs. This includes building on local knowledge and actively engaging local stakeholders on previous pilots in the region that could be replicated or scaled-up and on experience from the pilots within this project. - Component 4 on Youth Forum will enhance the beyond-project capacity for further uptake. Lessons can be learned from regional and national groundwater projects and organizations to work in low-capacity environments, such as the GEF project on Sustainable Groundwater Management in SADC Member States, interventions and learnings by SADC-GMI, ANBO, OSS and IGA 	Low
Institutional risks			

Lack of commitment from stakeholders.	High	<ul style="list-style-type: none"> - G4DR builds on a solid foundation of key stakeholders (MSs, RECs, R/LBOs), established as part of the inception phase of APAGroP, to which this project closely links. - The international project partners have previously collaborated with the national partners and various local stakeholders. The project proposes to collaborate with the regional partners (SADC-GMI, IGAD, OSS) and various development partners (FAO, UNESCO, IAEA, IGRAC, BGR, BGS, the World Bank, etc.) already active within the case study regions, which should mitigate some of this risk. - AMCOW, as a key partner of the project, has a strong convening power and facilitates regular meetings and targeted participatory processes from which this project will link and benefit from. 	Medium
Lack of cross-sector cooperation and policy reforms.	High	<ul style="list-style-type: none"> - G4DR aims to bring together stakeholders and representatives from different sectors into the proposed stakeholders' engagement activities to discuss groundwater risks and opportunities at continental and national scales, and therefore encourage cross-sector dialogue and cooperation through AMCOW. - The local project partners are well-connected to major sectoral players in their respective countries, which will help mobilize and engage with them. 	Medium
APAGrop second phase won't be in place, which potentially limit financing for the groundwater desk.	Medium	<ul style="list-style-type: none"> - G4DR primarily aims to sustain and strengthen groundwater desk at AMCOW as detailed in Component 1 with a significant share of the G4DR resources allocated. - Options for financial sustainability of the groundwater desk after the project will also be explored between the project partners and relevant external partners (e.g., development banks). 	Low
Low enabling environment and changing government priorities/low availability of co-financing.	Medium	<ul style="list-style-type: none"> - The project will support an enabling environment and aim to bring on board governments and stakeholders with low capacity through established and new facilitation pathways. - The project will use peer pressure to encourage governments with less capacity to come forward to take part in and benefit from the project. Since the project works at pan-African level, it holds some flexibility in terms of applying adaptive management and directing activities towards governments and stakeholders, demonstrating buy-in, up-take capacity and co-financing opportunities. 	Low

Limited sustainability of project activities postcompletion.	Medium	<p>- Enhanced capacity of AMCOW as a central node for groundwater planning at a pan-African level: G4DR primarily aims to sustain and strengthen groundwater desk at AMCOW as detailed in Component 1 with enhanced capacity and use of advanced assessment tools and the development of frameworks for groundwater planning and coordination. A significant share of the G4DR resources is allocated to AMCOW. This enhanced capacity will allow AMCOW to continue with/lead in the future the activities proposed in the project and maintain and further develop some of the project outputs such as the Groundwater Planning Assessment Framework, inventory of groundwater data, and Pan-African groundwater assessment.</p> <p>- Stakeholders? buy-in: G4DR aims to engage with a wide range of stakeholders at different levels. The project collaborates with the national partners and stakeholders in the case studies, regional partners (SADC-GMI, IGAD, OSS) and various key development partners (FAO, UNESCO, IAEA, IGRAC, BGR, BGS, the World Bank, etc.) already active in Africa and within the case study regions. Moreover, G4DR will engage with the youth through the proposed Youth Forum. This strong stakeholder involvement in the project is expected to lead to raising awareness about groundwater and sustained efforts by the participating organizations/individuals in maintaining/further developing some of the project outputs.</p> <p>- Financial support for follow-up: G4DR plans to explore options for financial sustainability of the groundwater desk at AMCOW after the project between the project partners and relevant external partners (e.g., development agencies, private sector organizations, NGOs) as part of activities 1.1.1.2 and 1.1.1.3 of Component 1. This will also include the possibility to provide financial support to maintain and further develop some of the project outputs such as the Groundwater Planning Assessment Framework, inventory of groundwater data, Pan-African groundwater assessment, and monitoring networks. Project partners IWMI and IIASA have a demonstrated track record of success in attracting funding for follow-up activities.</p>	Low
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COVID-19 pandemic: Short, medium, and long-term effects

The COVID-19 pandemic has had significant impacts on African countries, both in terms of public health and socio-economic effects. As of March 2022, there have been over 10 million confirmed cases and over 257,000 deaths in Africa due to COVID-19.

The pandemic has strained healthcare systems and resources in many African countries, many of which already have limited capacity. The pandemic has also led to disruptions in healthcare services, including routine immunizations, antenatal care, and other essential health services.

In addition to the public health impacts, COVID-19 has had significant socio-economic effects in African countries. The pandemic has resulted in job losses, reduced economic activity, and disrupted supply chains. Many people have experienced reduced incomes and increased food insecurity, and the pandemic has highlighted existing inequalities and vulnerabilities in African societies.

Furthermore, the pandemic has had a significant impact on education, with school closures affecting millions of students across the continent. The digital divide has also been exacerbated, as many students do not have access to online learning resources.

The pandemic has also highlighted the need for increased investment in healthcare systems and social safety nets in African countries. Many countries have implemented measures to support vulnerable populations, including cash transfers and food assistance programs.

Overall, the COVID-19 pandemic has had significant impacts on African countries, highlighting the need for increased investment in healthcare, social protection, and other essential services to build resilience and better prepare for future crises.

According to the World Health Organization (WHO), as of March 13, 2023, there have been a total of 117,633 confirmed cases of COVID-19 in Uganda since the beginning of the pandemic, with 2,825 deaths. The daily average number of new cases has been decreasing in recent weeks, with an average of around 200 new cases per day reported in the past week.

As for vaccinations, the Ministry of Health reported that as of March 12, 2023, a total of 8,940,516 vaccine doses had been administered in Uganda. Of these, 5,269,729 were first doses and 3,670,787 were second doses. The vaccination campaign has been ongoing since March 2021, with the government initially prioritizing healthcare workers, the elderly, and those with underlying health conditions. In more recent months, the vaccination campaign has expanded to include the general population.

It is worth noting that, as with many countries, there have been challenges with vaccine supply and distribution in Uganda, which have impacted the overall vaccination rate. However, the government and international partners continue to work towards improving access to vaccines and increasing the vaccination rate in the country.

As of March 11, 2023, Malawi reported a total of 214,643 confirmed cases with 190,564 recoveries and 3,931 deaths.

About 9.6% of the population is vaccination rate (at least one dose) and 4.7% is fully vaccinated.

The Malawian government has implemented several measures to control the spread of the virus, including mandatory wearing of face masks in public, limits on public gatherings, and restrictions on international travel. These measures have been effective in reducing the number of new cases and deaths. The government has also launched a COVID-19 vaccination campaign, targeting priority groups such as healthcare workers and people with underlying health conditions. However, there is still a long way to go to reach herd immunity.

The impact of COVID-19 on Malawi's economy has been significant, with disruptions in supply chains, reduced demand for exports, and a decrease in tourism. The government has implemented measures to mitigate the economic impact, including tax breaks and stimulus packages for small businesses. However, the country's economic recovery is dependent on the global response to the pandemic and access to vaccines.

In summary, while the number of COVID-19 cases in Malawi has decreased since the peak in April 2021, vaccination rates remain low and the economic impact of the pandemic is still significant. The government's efforts to control the spread of the virus and mitigate the economic impact will continue to be important in the coming months.

As of March 11, 2023, Mozambique has reported a total of 236,789 confirmed COVID-19 cases and 3,581 deaths. The country has a population of approximately 31 million people, and the current infection rate is 7.6 cases per 10,000 population.

The country has been implementing a COVID-19 vaccination program since March 2021, and as of the most recent data available, 2,924,509 doses have been administered. This corresponds to a vaccination rate of 9.4 doses per 100 people.

Mozambique has faced a number of challenges in managing the COVID-19 pandemic, including limited healthcare infrastructure, widespread poverty, and ongoing conflicts in certain regions of the country. The government has taken steps to mitigate the spread of the virus, including the implementation of mask mandates, social distancing guidelines, and limitations on public gatherings.

As of March 2023, Mozambique is experiencing a relatively stable number of new COVID-19 cases, with an average of around 100 new cases per day. However, there is concern about the emergence of new variants of the virus and the potential for a new surge in cases.

It is worth noting that the data on COVID-19 in Mozambique is still evolving, and the situation may change rapidly depending on various factors such as the effectiveness of the vaccination campaign, the emergence of new variants, and the implementation of public health measures.

The design of the proposed project has taken steps to minimize the risks related to the COVID-19 global pandemic in the area of community health. There is a risk that travel to or from areas where COVID-19 is prevalent could pose a risk to the basins' population, and to project staff, consultants/contractors. The project detailed design will include active steps to mitigate this risk, including training on pandemic-related guidance for project staff and stakeholders during the inception phase, and the expansion of standard monitoring of project operations and ensure that they are in conformity with FAO policies regarding travel, risk reduction, and other areas regarding the COVID-19 pandemic. The Project Manager will report on compliance to the Project Steering Committee and take any necessary steps to protect the health of staff, consultants/contractors, and beneficiaries required by the situation.

The COVID-19 pandemic affects jobs and livelihoods in many sectors, including those related to freshwater resources. The proposed project will improve the resilience of communities to climate change, conservation of the integrity of freshwater ecosystems, and fostering environmentally sustainable water

resources management, which in combination will improve the COVID related recovery process and improve the long-term resilience of communities to future shocks.

6. Institutional Arrangement and Coordination

Describe the institutional arrangement for project implementation. Elaborate on the planned coordination with other relevant GEF-financed projects and other initiatives.

6.a Institutional arrangements for project implementation.

FAO will be the GEF Implementing Agency. FAO plays an oversight role, particularly regarding project monitoring and reporting to GEF. FAO's Land and Water Division (NSL) will mainly assist with aspects of project implementation, acting as the lead technical unit (with the FAO Lead Technical Officer embedded in the project team), to ensure the technical and economic feasibility of the measures introduced by the project, and to facilitate sharing of experiences with other regions.

The project will be implemented in partnership with IWMI, AMCOW and IIASA. The Executing Agency (EA) and Operational Partner (OP) to the project will be IWMI who led together with FAO, IIASA and AMCOW the development of the project. IWMI will subcontract AMCOW and IIASA for the execution of the project.

IWMI will be responsible for managing the project, including day-to-day operations with national entities subcontracted to run activities at the national and local levels. **The PMU will sit in ADC-GMI. The PMU will be responsible for the global-level project activities (project coordination, day-to-day project management, knowledge management and lessons exchange, and common capacity-building activities).** Project monitoring will be led by a National Knowledge Management, Communications & M&E officer, leveraging existing M&E mechanisms in the region, including continued alignment with national monitoring frameworks, and use of common monitoring indicators where possible. A project Mid-Term Review will provide an independent assessment on project progress after two years of implementation and an opportunity to adjust/improve project execution if required, supporting adaptive management. At the stage of mid-term review, a plan will be formulated to migrate PMU to AMCOW.

IWMI and AMCOW will collaborate in execution of component 1. This will be done by leading these components' activities which focus heavily on engagement with key partners such as RECs, RBOs and pilot countries. IWMI is a non-profit, research-for-development organization that works with governments, civil society and the private sector to solve water problems in developing countries and scale up solutions. Through the partnership, IWMI combines research on the sustainable use of water and land resources, knowledge services and products with capacity strengthening, dialogue and policy analysis to support the implementation of water management solutions for agriculture, ecosystems, climate change and inclusive economic growth. IWMI is headquartered in Colombo, Sri Lanka, and has offices in 13 countries across Asia and Africa. IWMI's vision is a water-secure world and its mission is to provide water solutions for sustainable, climate-resilient development. IWMI has a staff complement of over 300 employees, and IWMI's team of over 100 researchers include environmental scientists, hydrologists and hydrogeologists, remote sensing and spatial analysts, irrigation and agricultural engineers, soil scientists, agronomists, water

governance and institutional specialists, ecologists and wetland specialists, economists and social scientists, water quality and health experts. IWMI has a strong presence across Africa, conducting projects from offices focusing on supporting the realization of Africa's enormous untapped potential for improved water management. IWMI also helps attain the objectives of the Comprehensive Africa Agriculture Development Program (CAADP), collaborates with the Secretariat of the African Ministers Council on Water (AMCOW) and supports various regional initiatives. These include the agricultural policy of the Economic Community of West African States (ECOWAS), the Agriculture and Rural Development Strategy and Food Security Action Plan of the East African Community, and the Regional Indicative Strategic Development Plan (RISDP) of the Southern African Development Community (SADC).

IWMI will also subcontract AMCOW to support the groundwater function which encompasses both a senior staff and resources for operational support to coordination activities. Through AMCOW, the project will support a coherent and coordinated 2nd phase of APAGroP, with inputs and investments from various partners and sources, to maximize the long-term outcomes of APAGroP.

IWMI will also subcontract IIASA to execute Component 2 with the support of AMCOW. This will be done by leading the development of analytical tools and supporting AMCOW in stakeholder engagements. IIASA has been at the forefront of methodological advances to tackle environmental issues, including water, food, energy, and biodiversity. The developed tools have been used for policy evaluation and decision-making in many parts of the world. IIASA has previously led the technical part of the **GEF-funded Integrated Solutions for Water Energy and Land (ISWEL)** project, which developed tools and capacities to support the sustainable management of water, energy and land, through the development of a truly nexus approach. In ISWEL, IIASA developed an integrated modelling assessment framework to explore and answer key questions regarding global nexus challenges and potential solutions to meet the sustainable development goals (SDGs). G4DR will build on those developments and seek to further improve the existing modelling assessment framework. Moreover, IIASA is already a partner in the GRIPP network and works closely with several research institutes and planning and funding agencies through the **Water Futures and Solutions (WFaS)** initiative. Moreover, IIASA is co-coordinating the development of the SSPs, which are the latest generation of global change scenarios and narratives for long-term climate change impact, adaptation, and mitigation assessments. The SSPs form the basis for comparative scenario analysis for the IPCC and will be used to define the global change narratives used in this project. IIASA is also a leading partner of the **Inter-Sectoral Impact Model Inter-comparison Project (ISI-MIP)**. G4DR will have many synergies with ISI-MIP, bringing together impact models from multiple sectors to examine climate change's biophysical and socio-economic impacts. Outputs from ISI-MIP will be used as inputs to G4DR assessment framework (e.g., climate change impacts on water availability). This project will also contribute to ISI-MIP in that it will focus on groundwater in Africa.

The project will engage and support key national institutions to ensure a smooth execution of the three pilots. In the Shire, the project will partner with key organizations in Malawi and Mozambique. In Malawi, key organizations will include the Ministry of Water and Sanitation, as well as the National Focal Group on Groundwater. In Mozambique, key institutes will include Dire??o Nacional de Gest??o de Recursos H??dricos (DNGRH) and Administra??o Regional de ?guas do Zambeze (ARA-Zambeze); this has recently been amalgamated into ARA-Centro. In Uganda, key partner will include the Ministry of Water and Environment, in addition to representants of several international organization in Uganda such as UNEP

and UNHCR. In Benin and Togo, the project will partner with the Mono Basin Authority as well as Ministry of Water and Mining (Benin) and Ministry of Water and Village Hydraulics (Togo). **To coordinate activities in each case study, a focal point will chair a technical committee in which key institutes in each case study will form part. Annex F outlines execution arrangements in pilots.**

Figure 11 provides an overview for the organization structure proposed for this project. Component 4 includes the implementation of a mechanism for structured exchanges with ongoing relevant projects and initiatives (see Baseline section above). The project will create effective links with other projects as listed in Table 3.

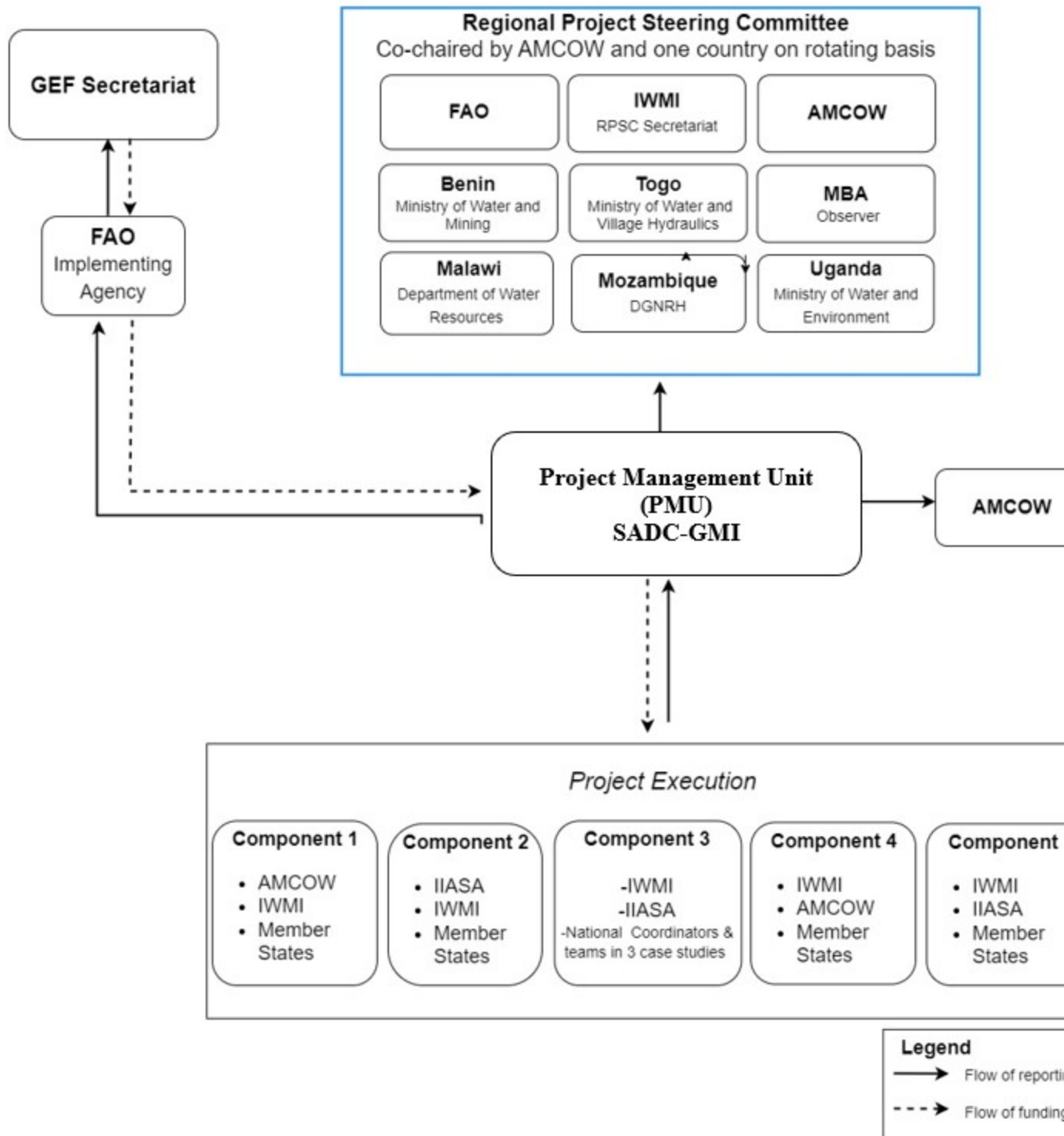
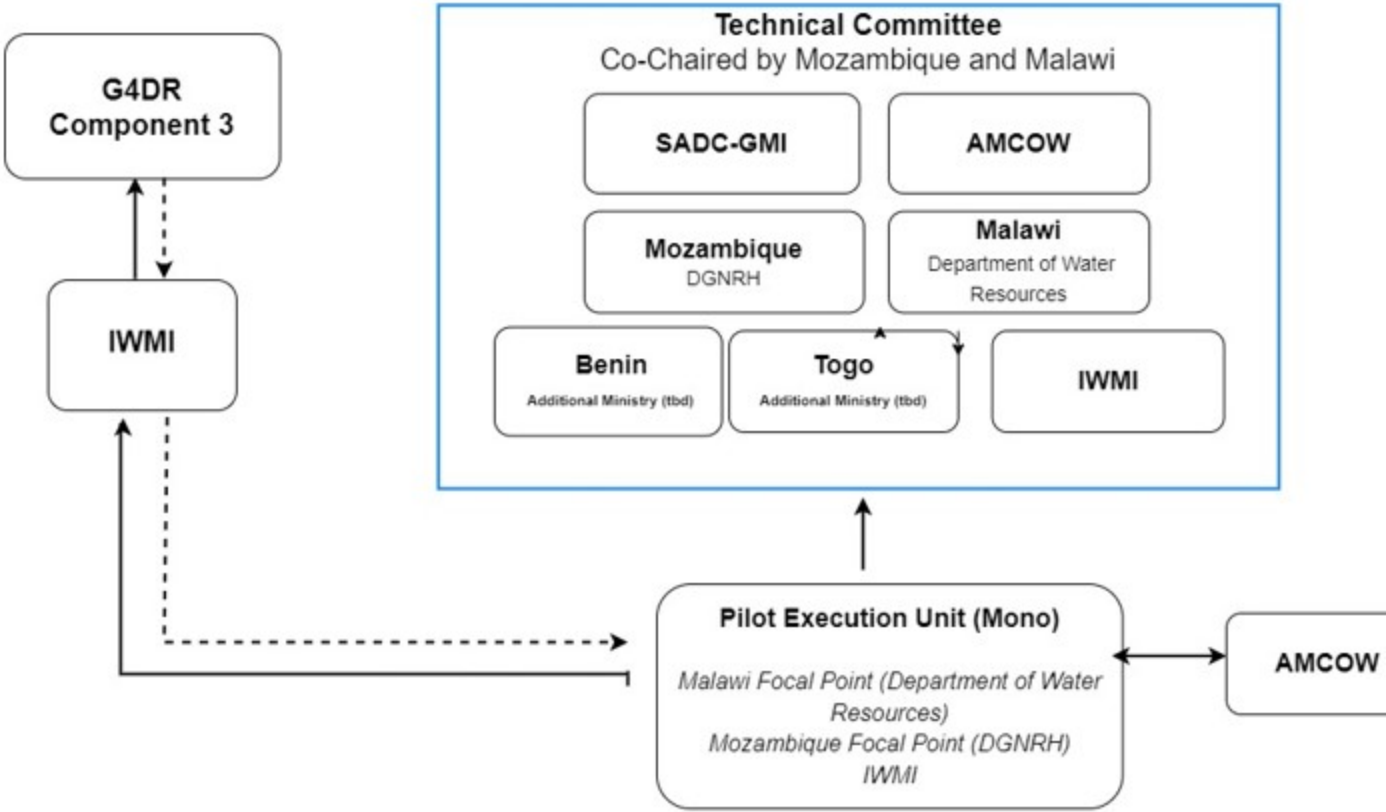
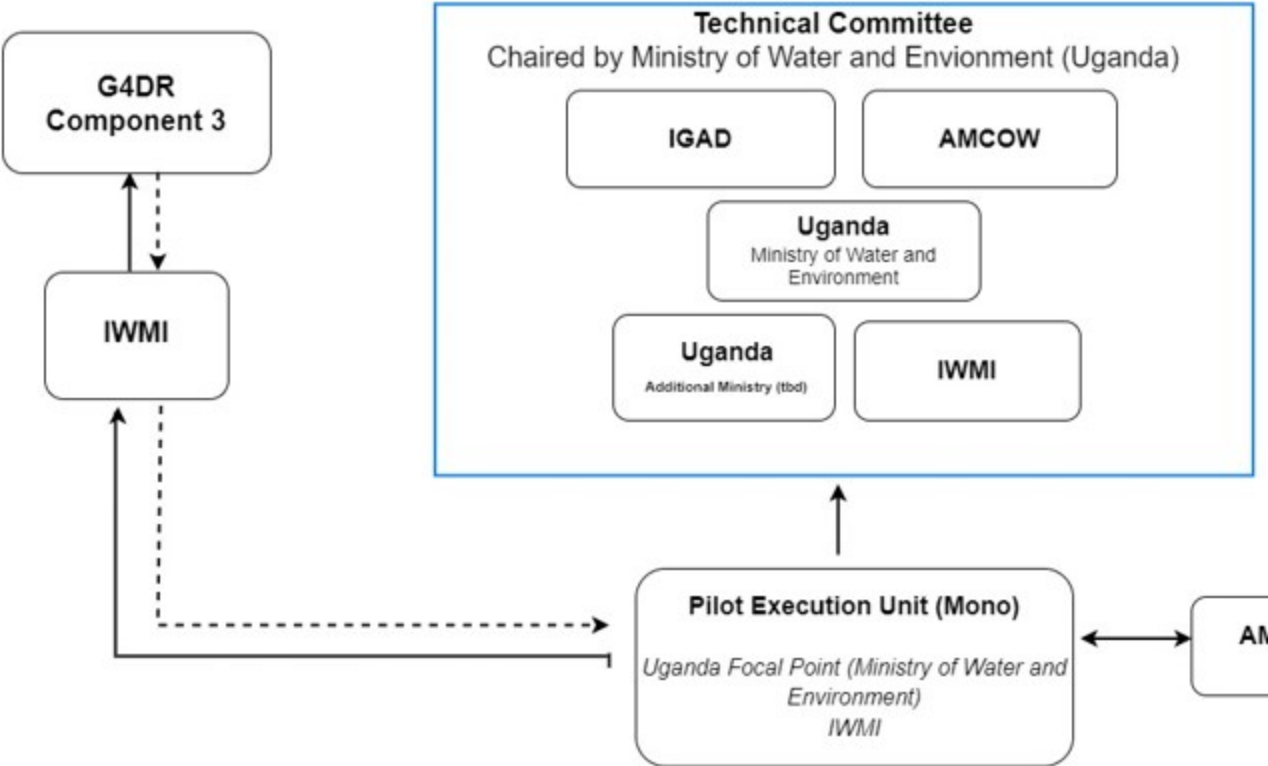


Figure 11. Project organizational structure

Shire Execution Arrangement



Uganda Execution Arrangement



Mono Execution Arrangement

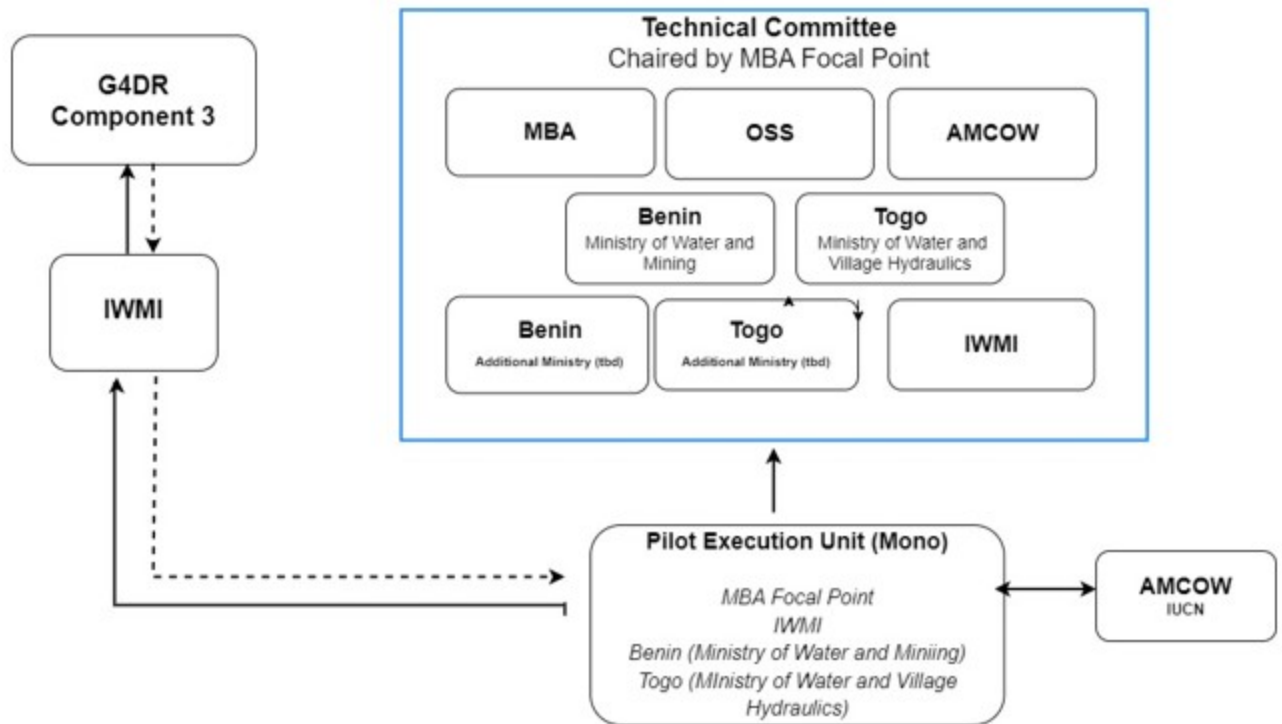


Figure 12. Organizational structure Pilot projects

A **Project Steering Committee (PSC)** will be established to provide strategic guidance to the Project Management Unit and to all executing partners and take decisions related to the project implementation including approval of annual work plans and budgets and revisions on an annual basis. AMCOW, the Government nominated Representatives of the beneficiary countries (case studies), FAO and representatives from IWMI, AMCOW and case study countries will form the project's Regional Steering Committee (RPSC). The Mono River Basin (Benin, Togo) will serve as an observer without voting privileges. The main role of the MBA will be to ensure transboundary coordination, to strengthen relations with national structures (Benin and Togo), and to ensure the sharing and dissemination of data, the supervision of all activities in the field and the capitalization of achievements.

The Beneficiary Representative's primary function within the RPSC is to ensure the realization of project results from the perspective of project beneficiaries and in accordance with the objectives of the project. The members of the RPSC will each assure the role of a Focal Point for the project in their respective agencies. Hence, the project will have a Focal Point in each concerned institution. As Focal Points in their agency, the concerned PSC members will: (i) technically oversee activities in their sector; (ii) ensure a fluid two-way exchange of information and knowledge between their agency and the project; (iii) facilitate coordination and links between the project activities and the work plan of their agency; and (iv) facilitate the provision of co-financing to the project. (Co-financing is defined as funding that is either provided to projects that will be implemented during the same period and focus in the same areas on the same issues ? so-called baseline

projects, see Table 1 on page 39. Co-financing can also imply investments provided to support the project directly.)

The PMU CTA and national coordinators will serve as Secretaries to the PSC. The PSC will meet at least twice per year to ensure:

- Oversight and assurance of technical quality of outputs;
- Close linkages between the project and other ongoing projects and programmes relevant to the project;
- Timely availability and effectiveness of co-financing support;
- Sustainability of key project outcomes, including up-scaling and replication;
- Effective coordination of governmental partners work under this project;
- Approval of the six-monthly Project Progress and Financial Reports, the Annual Work Plan and Budget;
- Making by consensus, management decisions when guidance is required by the National Project Coordinator of the PMU.

The PMU will consist of the following staff: Chief Technical Adviser, Technical Support Officer and 2 Financial Support Officers. The PMU will oversee daily execution, management, administration and technical supervision of the project, on behalf of the Operational Partner and within the framework delineated by the RPSC. They will be responsible, among others, for:

- a. Overall technical lead for the implementation of all project outputs and activities and ensure technical soundness of project implementation;
- b. Coordination and close monitoring of the implementation of project activities;
- c. Coordination with relevant initiatives and activities by other projects including other GEF-financed projects;
- d. Ensuring a high level of collaboration among participating institutions and organizations at the national and local levels;
- e. Ensuring compliance with the Operational Partners Agreement (OPA) provisions respectively during the implementation, including on timely reporting and financial management;
- f. Tracking the project's progress and ensuring timely delivery of inputs and outputs, including targets for the project's indicators in line with the results framework.;
- g. Leading and supervising the preparation of various technical outputs, e.g., knowledge products, reports and case studies;
- h. Ensuring meaningful engagement of stakeholders as per the Stakeholder Engagement Plan;
- i. Ensuring that all project resources are used solely to achieve project objectives consistent with the approved work plan and budget and government financial policies and FAO/GEF requirements;
- j. Providing technical support and assessing the outputs of the project national consultants hired with GEF funds, as well as the products generated in the implementation of the project, including knowledge management and communication outputs;
- k. Approving and managing requests for provision of financial resources using provided format in OPA annexes;
- l. Monitoring financial resources and accounting to ensure accuracy and reliability of financial reports;
- m. Ensuring timely preparation and submission of requests for funds, financial and progress reports to FAO as per OPA reporting requirements;

- n. Maintaining documentation and evidence that describes the proper and prudent use of project resources as per OPA provisions, including making available this supporting documentation to FAO and designated auditors when requested;
- o. Implementing and managing the project's monitoring and communications plans;
- p. Organizing project workshops and meetings to monitor progress and preparing the Annual Budget and Work Plan;
- q. Submitting the six-monthly Project Progress Reports (PPRs) with the AWP/B to the RPSC and FAO;
- r. Preparing the first draft of the Project Implementation Review (PIR);
- s. Supporting the organization of the mid-term review in close coordination with the FAO Budget Holder and the GEF Coordination Unit.
- t. Supporting the organization of the terminal evaluation in close coordination with the FAO Budget Holder and the FAO Independent Office of Evaluation (OED).
- u. Submitting the OP required technical and financial reports to FAO and facilitate the information exchange between the OP and FAO, if needed;
- v. Informing the PSC and FAO of any delays and difficulties as they arise during the implementation to ensure timely corrective measure and support.
- w. Providing draft terminal report for BH two months before the ending date of the OPA or the project;

FAO will be the GEF Implementing Agency (IA) for the Project, providing project cycle management and support services as established in the GEF Policy. As the GEF IA, FAO holds overall accountability and responsibility to the GEF for delivery of the results. In the IA role, FAO will utilize the GEF fees to deploy four different actors within the organization to support the project (see Annex J for details), who form the key members of the FAO Project Task Force (PTF):

- a. The Budget Holder, the FAO Assistant Director General, Regional Office for Africa (RAF), will provide oversight of day-to-day project execution;
- b. The Lead Technical Officer from FAO's Regional Office for Africa, in collaboration with experts drawn from across FAO will provide oversight/support to the projects technical work in coordination with government representatives participating in the Project Steering Committee;
- c. The Funding Liaison Officer(s) within FAO will provide oversight support to the project cycle to ensure that the project is being carried out and reporting done in accordance with agreed standards and requirements.
- d. HQs Technical Officer from FAO HQs to provide technical support as needed.

FAO responsibilities, as GEF implementing agency, will include:

- a. Administrate funds from GEF in accordance with the rules and procedures of FAO;
- b. Oversee project implementation in accordance with the project document, work plans, budgets, agreements with co-financiers, Operational Partners Agreement(s) and other rules and procedures of FAO; It should be noted that the results to be implemented by the OP and budgets to be transferred to the OP are non-binding and may change due to FAO internal partnership and agreement procedures which may not have been concluded at the time of project submission.
- c. Provide technical guidance to ensure that appropriate technical quality is applied to all activities concerned;

- d. Conduct at least one supervision mission per year;
- e. Report to the GEF Secretariat and Evaluation Office, through the annual Project Implementation Review, the Mid Term Review, the Terminal Evaluation and the Project Closure Report on project progress;
- f. Financial reporting to the GEF Trustee.

TORs of key staff and consultants to be hired by the project are included in Annex M.

6.b Coordination with other relevant GEF-financed projects and other initiatives.

Some contacts have already been made, in order to identify such linkages, e.g. with the GEF Conjunctive Water Management project for the Nile Basin Initiative (bit.ly/3okfhy2) and various other transboundary projects with a focus on aquifers, e.g. the GEF project under the Nile Basin Initiative focusing on the Kagera aquifer shared by Burundi, Rwanda, Tanzania and Uganda, the Mt. Elgon aquifer shared by Kenya and Uganda, and Gedaref-Adigrat aquifer shared by Ethiopia and Sudan (bit.ly/3Df3Njv), WB/CIWA support to groundwater and centers of excellence in SADC, IGAD, and Sahel (CIWA/WB, 2021), AfDB/AWF support to North-Western Sahara Aquifer System, Iullemeden and Taoud?ni Aquifer Systems, and Niger River and Aquifer Basin (bit.ly/3lyKiwi), and work on transboundary aquifers in ECOWAS (ECOWAS-SWAC/OECD, 2006).

The project will engage and coordinate with the GEF ID 10797 Sustainable Groundwater Management in SADC Member States Project Phase 2, aiming at developing capacity and knowledge for inclusive groundwater management in the SADC region at the national and transboundary levels.

The project will engage and coordinate with the Climate Change and Desertification Unit (CCDU) of the AU, the Committee of African Heads of State and the Government on Climate Change (CAHOSCC), the African Ministerial Conference on the Environment (AMCEN) and the ClimDEV Africa initiative.

Finally, the project will explore opportunities to engage and coordinate with partners in the field of transboundary waters and climate change, but which seem to have limited groundwater considerations, e.g. the AGWA initiative for a new tool (the Water Tracker) for countries to integrate water resilience into national climate plans (bit.ly/32JG8v1), the GWP initiative towards an International High-Level Panel for Climate Resilient Water Investments in Africa, called for a high level at COP26 (bit.ly/3rxpwks) and AMCOW-GWP capacity building initiatives around climate resilient decision-making in water investments (bit.ly/3Ij6tR9).

The project will utilize outputs and build on outcomes established by a series of completed GEF projects:

- GEF ID: 10145, "Integrated Land and Water Resources Management in the Cross-Border Area of the Zambezi River Basin (Mozambique, Zambia, Zimbabwe)," Period: 2013-2021, Budget: \$11,500,000, Geographical Focus: Mozambique, Zambia, Zimbabwe.
- GEF ID: 10263, "Institutional Strengthening for Integrated Management of Lake Tanganyika," Period: 2015-2021, Budget: \$5,982,000, Geographical Focus: Burundi, Democratic Republic of Congo, Tanzania, Zambia.

- GEF ID: 10409, "Securing Watershed Services through Sustainable Land Management in the Shire River Basin," Period: 2018-2023, Budget: \$7,715,000, Geographical Focus: Malawi.

The project will also coordinate activities and stakeholder engagement processes with a range of ongoing GEF investments to realize synergies:

- GEF ID: 10525, "Sustainable Management of the Lake Edward and Lake Albert Fisheries (SMLAF)," Period: 2020-2026, Budget: \$13,466,000, Geographical Focus: Democratic Republic of Congo, Uganda.
- GEF ID: 10587, "Addressing Land Degradation and Maintaining Ecosystem Services for Sustainable Livelihoods in the Lake Kivu Basin," Period: 2021-2028, Budget: \$7,850,000, Geographical Focus: Burundi, Democratic Republic of Congo, Rwanda.
- GEF ID: 10603, "Conserving Critical Wetlands and Associated Catchments in the Tana and Athi River Basins," Period: 2021-2028, Budget: \$5,600,000, Geographical Focus: Kenya.
- GEF ID: 10641, "Sustainable Management of Shared Living Marine Resources in the Southwest Indian Ocean Large Marine Ecosystem," Period: 2022-2028, Budget: \$18,350,000, Geographical Focus: Comoros, Madagascar, Mauritius, Mozambique, Seychelles, Tanzania.
- GEF ID: 10671, "Mainstreaming Biodiversity Conservation and Sustainable Use into Production Landscapes and Sectors in Africa," Period: 2022-2029, Budget: \$106,900,000, Geographical Focus: 30 African countries, including those in East, West, Central and Southern Africa.

G4DR collaboration with RIWE-Mono

	IREE project (OSS) Regional Initiative for Water and Environment in the transboundary basin of the Mono River (RIWE-Mono)	G4DR in Africa project (IWMI) Groundwater for Deep Resilience in Africa (G4DR in Africa)	Collaboration
<i>Project objective</i>	<i>The overall objective of the project is the development of good practices related to water, ecosystems, and adaptation to climate change for sustainable services to people and nature in the Mono River basin.</i>	<i>To bring groundwater and its sustainable development and protection to the forefront of water security, adaptation planning, and investment in Africa, enhancing deep resilience for humans and ecosystems.</i>	

<i>Component</i>	Component 1: Mono River Basin development assessment and planning. Under this component, various activities will allow us to address the information gap with regard to water resources in the Mono Basin.	Component 3: Demonstrating benefit: Utilizing evidence-based planning to realize on-the-ground impacts in pilots.	
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<p><i>Outcome and output</i></p>	<p>Outcome 1.1: The threats and potential of the Mono River Basin are assessed, and their sustainable use is planned.</p> <p>Output 1.1.1: <i>A transboundary diagnostic analysis (TDA) of Mono waters, including groundwater, is completed, approved by both countries, and published.</i></p> <p>Output 1.1.2: A Strategic Action Plan (SAP) is developed for 2024-2028, approved and signed at the appropriate national ministerial level by both countries, along with an investment plan at the SAP horizon.</p> <p>Output 1.1.3: A strategic framework and tools for ecological monitoring of water (surface and groundwater) in the Mono Basin are developed (database, GIS, etc.)</p> <p>Outcome 1.2: Pilot integrated interventions to enhance suitable use of the basin resources, economic development, as well as environment protection and population adaptation and resilience to climate change.</p> <p>Output 1.2.1: Pilot activities on integration of CC into IWRM, pollution control at source, transboundary PA co-management, conservation of biodiversity of global interest, local community mobilization, and knowledge management for IWRM in the Mono River Basin are conducted, and lessons learned.</p>	<p>Outcome 3.3: Supporting Integrated Aquifer Management & reducing Groundwater Risks in the Shared Mono Basin.</p> <p>Output 3.3.1: Gender and Water Assessment for the shared Mono basin</p> <p>Output 3.3.2 Design of harmonized groundwater monitoring network and data loggers installed.</p> <p>Output 3.3.3: Water quality monitoring and laboratory analysis</p> <p>Output 3.3.4: Shared data platform to support improved aquifer planning.</p> <p>Output 3.3.5 Strategic well rehabilitation to reduce flood risk to drinking water supplies.</p>	<p><i>The two components are complementary and contribute to achieving the objective of sustainable water resources management in the Mono Basin.</i></p> <p><i>Outputs 3.3.2 and 3.3.3 of the G4DR project align with the strategic framework and tools for ecological monitoring (surface and groundwater) to be developed under the IREE project (Output 1.1.3). Water-quality monitoring information protects human health to preserve and restore healthy ecological conditions.</i></p> <p><i>The groundwater level data monitored in the G4DR project (Output 3.3.2) will be used to develop the hydrogeological model as part of the TDA/SAP under the IREE project (Output 1.1.1 and 1.12).</i></p> <p><i>Output 3.3.3 of the G4DR in Africa project aims to identify contaminants of water quality concerns and has clear synergy with Output 1.2.1 of the IREE project (pollution control at source).</i></p> <p><i>Output 3.3.4 of G4DR is complementary to Activity 1.2.1.5 of the IREE project (i.e., Development of an inter-communal framework to support cross-border Community Cooperation for concerted management of transboundary resources).</i></p>
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The project will also coordinate with ongoing and planned investments by the **Government of Malawi** and international donors, which predominantly aim to mitigate the impacts of climate change on groundwater resources in the Shire aquifer. These initiatives include:

- Promotion of climate-smart agriculture practices to reduce water demand and increase groundwater recharge. This includes the adoption of conservation agriculture, agroforestry, and other sustainable land management practices that improve soil health and water retention capacity.
- Strengthening of water management institutions and policies to ensure sustainable and equitable groundwater allocation. This includes the development of legal frameworks and regulations that promote efficient and effective groundwater use, and the establishment of monitoring systems to track groundwater abstraction and recharge.
- Implementation of climate-resilient water supply systems to ensure access to safe and reliable water for domestic, agricultural, and industrial use. This includes the construction of small-scale irrigation schemes, boreholes, and other water supply infrastructure that can withstand climate variability and extreme weather events.
- Education and awareness-raising campaigns to promote behavior change and community participation in groundwater management. This includes the provision of training and extension services to farmers and other groundwater users on sustainable water use practices, and the promotion of community-based groundwater monitoring and management initiatives.

These initiatives are expected to improve the resilience of groundwater resources in the Shire aquifer to climate change and enhance the livelihoods of local communities that depend on them.

The project will also build on a range of initiatives in Mozambique. The Government of Mozambique has initiated several projects to mitigate the impacts of climate change on groundwater resources, including the Shire aquifer. These projects include:

- Development of a National Climate Change Adaptation Plan (NCCAP): The NCCAP was developed in 2018 to provide a framework for adaptation to climate change impacts in Mozambique. The plan includes specific strategies for groundwater management and adaptation, including promoting the use of groundwater recharge techniques and improving monitoring and management of groundwater resources.
- Water Resources Management and Development Project (WRMDP): The WRMDP is a project funded by the World Bank and implemented by the Government of Mozambique. The project aims to improve the management and development of water resources, including groundwater, in Mozambique. Specific activities related to groundwater include the drilling of boreholes and the installation of monitoring wells to improve knowledge and management of groundwater resources.
- JICA Mozambique: The Japan International Cooperation Agency (JICA) has been working with the Government of Mozambique to improve groundwater management in the country. One of the main initiatives is the Shire River Basin Management Project, which aims to improve the management of water resources in the Shire River Basin, including the Shire aquifer. Specific activities include the installation of monitoring wells, promotion of rainwater harvesting, and the development of a groundwater management plan.
- The World Bank has supported the development of the Incom?ti Basin Water Resources Management Plan, which includes a groundwater management component (World Bank, 2014). The plan aims to

improve the management of groundwater resources in the basin by promoting sustainable use, reducing pollution, and increasing access to safe and reliable water sources.

- The African Development Bank has also supported initiatives to improve groundwater management in the Shire aquifer. In 2017, the bank approved funding for the implementation of the Ch?kw? Integrated Water Supply and Sanitation Project, which includes the construction of a groundwater recharge system to increase the availability of water in the aquifer (AfDB, 2017).

In addition to these ongoing initiatives, the Government of Mozambique has also planned several future projects to mitigate the impacts of climate change on groundwater resources. These include:

- Climate Resilient Water Supply Project: This project, funded by the African Development Bank, aims to improve access to safe and reliable water supply in urban and peri-urban areas of Mozambique, including through the development of groundwater resources.
- National Water Resources Development and Management Master Plan: The Government of Mozambique is in the process of developing a National Water Resources Development and Management Master Plan, which includes specific strategies for groundwater management and adaptation to climate change impacts.

Overall, these initiatives and planned projects demonstrate the Government of Mozambique's commitment to improving groundwater management and adapting to the impacts of climate change on groundwater resources in the country, including the Shire aquifer.

In Uganda the four following projects are most relevant for the context of improved groundwater management:

- The Groundwater Resilience to Climate Change in the Rwenzori Region (GRCCR) project:
 - Implementation period: 2018-2022
 - Budget: USD 3.7 million (funded by UNDP)

The Groundwater Resilience to Climate Change in the Rwenzori Region (GRCCR) project: This is a five-year project funded by the United Nations Development Programme (UNDP) and implemented by the Uganda Ministry of Water and Environment. The project aims to strengthen the resilience of communities in the Rwenzori region to climate change by improving their access to and management of groundwater resources. The project includes activities such as mapping and monitoring of groundwater resources, capacity building for water user associations, and the promotion of climate-resilient water management practices.

- The Sustainable Groundwater Management in Uganda project:
 - Implementation period: 2021-2026
 - Budget: USD 25 million (funded by the World Bank)

The Sustainable Groundwater Management in Uganda project: This is a five-year project funded by the World Bank and implemented by the Uganda Ministry of Water and Environment. The project aims to improve the sustainability of groundwater resources in Uganda by strengthening institutional capacity for

groundwater management, promoting sustainable groundwater use practices, and supporting the development of groundwater monitoring systems.

- The Integrated Water Resources Management (IWRM) project:
 - Implementation period: 2018-2024
 - Budget: EUR 30 million (funded by the European Union)

The Integrated Water Resources Management (IWRM) project is a six-year project funded by the European Union and implemented by the Uganda Ministry of Water and Environment. The project aims to promote the sustainable management of water resources in Uganda through the adoption of an integrated water resources management approach. The project includes activities such as the development of water allocation plans, the promotion of water use efficiency and conservation, and the strengthening of stakeholder participation in water management.

- The GIZ Water and Sanitation Sector Reform Programme:
 - Implementation period: 2018-2023
 - Budget: EUR 33.7 million (funded by the German Government)

The GIZ Water and Sanitation Sector Reform Programme is a five-year programme funded by the German Government and implemented by the German Agency for International Cooperation (GIZ) in partnership with the Uganda Ministry of Water and Environment. The programme aims to improve the governance and management of the water and sanitation sector in Uganda, including the sustainable management of groundwater resources. The programme includes activities such as capacity building for local government authorities, the promotion of public-private partnerships in water service provision, and the support of groundwater monitoring and management systems.

7. Consistency with National Priorities

Describe the consistency of the project with national strategies and plans or reports and assessments under relevant conventions from below:

NAPAs, NAPs, ASGM NAPs, MIAs, NBSAPs, NCs, TNAs, NCSAs, NIPs, PRSPs, NPFE, BURs, INDCs, etc.

National priorities in pilots: National priorities are listed below for those countries involved in the pilots. As pilots expect to focus at a national level in Uganda and at a transboundary level in the transboundary Shire aquifer system (Malawi, Mozambique), descriptions of relevant national institutions are provided for the following five countries: Benin, Malawi, Mozambique, Togo and Uganda.

Benin

In Benin, the main national priorities regarding sustainable groundwater management and dependent ecosystems include:

- Improving access to safe and clean water: One of the key priorities in Benin is to improve access to safe and clean water for all, particularly in rural areas where access to water is limited. This involves ensuring the sustainability of groundwater resources through effective management practices.
- Protecting wetlands and other dependent ecosystems: Wetlands and other dependent ecosystems in Benin are under threat from human activities such as agriculture and urbanization. To protect these ecosystems, the government of Benin has developed policies and regulations to regulate land use practices and ensure sustainable management of these resources.
- Strengthening governance and institutional frameworks: Effective governance and institutional frameworks are essential for sustainable groundwater management and the protection of dependent ecosystems. In Benin, efforts are being made to strengthen the governance structures and institutional frameworks that support sustainable water management practices.
- Promoting community participation and awareness-raising: Engaging local communities in sustainable groundwater management and the protection of dependent ecosystems is crucial for ensuring the long-term sustainability of these resources. In Benin, efforts are being made to raise awareness among local communities and involve them in decision-making processes related to water management.
- Improving data collection and monitoring: Reliable data on groundwater resources and dependent ecosystems are essential for effective management practices. In Benin, efforts are being made to improve data collection and monitoring systems to support evidence-based decision-making and management practices.

These national priorities are reflected in the policies and programs of the government of Benin, in particular:

- National Water Policy (2014): This policy provides guidance for the management and development of water resources in Benin, with a focus on ensuring access to safe and clean water for all. It is implemented by the Ministry of Water and Mines.
- National Action Plan for Integrated Water Resources Management (NAP/IWRM) (2016): This plan outlines the strategies and actions required to achieve sustainable and integrated water resources management in Benin. It is implemented by the Ministry of Water and Mines.
- National Wetlands Policy (2018): This policy aims to promote the conservation and sustainable use of wetlands in Benin, with a focus on their role in supporting biodiversity, climate change adaptation, and sustainable livelihoods. It is implemented by the Ministry of Environment and Sustainable Development.
- National Forest and Wildlife Policy (2002): This policy provides guidance for the management and conservation of forests and wildlife in Benin, with a focus on promoting sustainable use and conservation of these resources. It is implemented by the Ministry of Environment and Sustainable Development.
- National Climate Change Adaptation Strategy (2014): This strategy provides guidance for adapting to the impacts of climate change in Benin, including strategies for managing water resources and ecosystems. It is implemented by the Ministry of Environment and Sustainable Development.

In addition to these policies and strategies, there are also several government agencies and institutions involved in the management and protection of groundwater and dependent ecosystems in Benin. These include:

- Ministry of Water and Mines: This ministry is responsible for the management and development of water resources in Benin, including groundwater resources.
- Ministry of Environment and Sustainable Development: This ministry is responsible for the protection and management of natural resources in Benin, including wetlands, forests, and wildlife.
- National Agency for the Promotion of Rural Electrification and Energy (ANPER): This agency is responsible for the development of renewable energy sources, including hydropower, which can have an impact on water resources and dependent ecosystems.
- National Institute of Water (INW): This institute is responsible for the collection and analysis of data related to water resources in Benin, including groundwater resources.
- National Agency for Civil Engineering Studies and Technical Studies (ANAT): This agency is responsible for the development and implementation of engineering projects related to water resources, including groundwater abstraction and irrigation projects.

Malawi

The Water Resources Act: The Water Resources Act is a high priority Act: The objective of the Act is to promote the rational management and use of the water resources of Malawi; to allow for the orderly development and use of water resources for all purposes; and to control pollution and to promote the safe storage, treatment, discharge and disposal of waste and effluents.

The Waterworks Act: The MoAIWD also heads the implementation of water supply (Baumann and Danert 2008; Matamula 2008; USAID n.d.). Water services are regulated in Malawi through the Waterworks Act of 1995, providing water services in urban areas. The Waterworks Act is the leading legislation mandating Public Utility Companies or Water Boards, as sole water service providers in designated urban areas and Market Centres, the boundaries of which the minister declares, and can alter, amend, reduce or extend.

National Water Resources Authority: The National Water Resources Authority (NWRA) is responsible for developing instruments, principles and guidelines for water resources allocation, granting water permits, liaising with different stakeholders on regulation and management of water resources, and water resources monitoring and data collection. However, it is yet to be operational and in its absence the DWR continues to facilitate and coordinate the proper management and utilization of water resources. Below the NWRA, the WRA of 2013 has provided for the opportunity to establish regional offices in or near any catchment area as the Authority may determine. The NWRA is structured with 4 main offices; the Headquarters and 3 Catchment Management Boards (CMBs) in the cities of Blantyre, Lilongwe and Mzuzu each one serving a number of the country's main catchments.

Water Boards: At Malawi's regional and district tiers, three regional and two district public water utility companies are sole water service providers in designated urban areas under the Waterworks Act. The five utility companies are Northern, Central and Southern Water Boards at the regional levels, and then Lilongwe and Blantyre Water Boards. Most of the water supply facilities in these cities are old. The aging

water facilities may cause various problems, such as the risk of accidents and failures with water supply interruption for a long time due to the deterioration of structural components.

Irrigation: Among the various other pieces of policies, legislation and institutions that affect water resources management, an important sector is irrigation. The Irrigation Act of 2001, together with the National Irrigation Policy of 2016 provides for the implementation and provision of irrigation-related goods, works and services. The Act provides guiding principles and the establishment of a relevant body for sustainable development and management of irrigation. The National Policy guides the provision of irrigation goods, works, and services regarding three critical issues affecting the irrigation sector: spatial and temporal water shortages; customary land tenure disputes; and poor operation and maintenance of infrastructure. The policy seeks to contribute to the attainment of food security, nutrition and sustainable economic growth. Specifically regarding water, the intended outcome is water productivity through catchment management and water harvesting.

Environment Management Act (2017) There are several other national, sectoral legislations and policies that impact the water sector. The revised Environment Management Act of 2017 is an integrated and comprehensive legal framework for environmental and natural resource conservation, sustainable utilization, protection, and management in Malawi.

Mozambique

Fundo de Investimento e Património do Abastecimento de água (FIPAG): The 1991 Mozambican Water Act also regulates domestic water supplies. The first National Water Policy of 1995 emphasized the goal of reconstruction and expansion of basic water provision to urban, peri-urban and rural areas. Specific institutional and financial frameworks for implementation have been established, which fall under the National Directorate for Water Supply and Sanitation, in the Ministry of Public Works, Housing and Water Resources. In 1998, the Decree n° 73/98 established the public Investment and Patrimonial Water Supply Fund (Fundo de Investimento e Património do Abastecimento de água (FIPAG)). Decree n°74/98 established the Water Supply Regulatory Council (Conselho de Regulação do Abastecimento de águas (CRA)). In 2004, the Ministerial Order No. 180/2004 was approved to regulate the water quality for human consumption (Manjate 2010).

Programa Nacional de Abastecimento de água e Saneamento Rural (PRONASAR): The FIPAG was for major cities, including the Maputo Region (águas da Região de Maputo). The framework allowed for private operators to be in charge of the management of five systems, while the assets and the investments were in the hands of FIPAG with its independent supervisor, CRA. In smaller cities and towns, the Management of Water Supply and Sanitation Infrastructure (Administração de Infraestruturas de Abastecimento de água e Saneamento, AIAS) operated. In rural areas, water supply and sanitation is coordinated through National Rural Water Sanitation Program (Programa Nacional de Abastecimento de água e Saneamento Rural (PRONASAR) from 2010 onwards. PRONASAR is striving to manage aid to the rural sector more effectively and to implement sector and institutional reforms that facilitate harmonization and alignment. Community participation is promoted, with rural water points (e.g., boreholes with hand pumps) managed by voluntary committees. In 2006, it was estimated that 85% of its funds came from grants and concessional loans.

Water Boards: Accordingly, in the Mozambican part of the Shire System, domestic water supplies are implemented by water boards in urban areas. In rural areas, local government collaborates with NGOs such as WaterAid and World Vision. For example, in Mutarara with a population of 208,864 inhabitants, 46.2% of the population has access to an improved water source, corresponding to 155 drill holes and 135 operational wells, 8 sources connected through small water supply systems. However, groundwater is reported to be saline. Morrumbala has 683 operational water sources in the area and the rural water supply rate is about 64.2% (water officials, pers. communication).

Irrigation and Fisheries At national level, the 10-year Strategic Plan for Agricultural Development 2010 ? 2019 (PEDSA) aims to develop irrigation schemes and boost agricultural production in order to improve food security and rural income competitively and sustainably. The PEDSA envisages doubling crop yields and increasing by 25% the area cultivated for basic food production by 2019. Investments in irrigation infrastructure, agricultural technologies, market-based approaches, and enabling environments such as physical infrastructure, financing mechanisms, and coordination are envisaged to achieve this goal. The Ministry of Agriculture (Minist?rio de Agricultura (MINAG)) is responsible for implementation.

Environment, The Ministry for the Coordination of Environmental Action (MICOA), is responsible for environmental protection. This mandate is also highly relevant in the Lower Zambezi. The operation of the upstream Cahora Bassa dam has already affected the livelihoods and ecosystems in the delta, which has also been declared as RAMSAR site (De Bruyne et al. 2017). In particular, Environmental Impact Assessment falls under the authority of the Direc??o Nacional de Auditoria e Impacto Ambiental authority.

Togo

In Togo, the national priorities regarding sustainable groundwater management and dependent ecosystems are:

- National Water Policy: Togo's National Water Policy, adopted in 2015, aims to ensure equitable access to water resources, promote the sustainable management of water resources, and improve the quality of water services. The policy recognizes the importance of protecting groundwater resources and promoting integrated water resources management.
- National Plan for the Development of Water Resources: Togo's National Plan for the Development of Water Resources (PNDRH), adopted in 2012, aims to improve access to water resources and promote their sustainable management. The plan includes measures to protect groundwater resources, promote their sustainable use, and improve monitoring and assessment of groundwater resources.
- National Climate Change Adaptation Strategy: Togo's National Climate Change Adaptation Strategy, adopted in 2013, recognizes the importance of groundwater resources in adapting to climate change impacts, particularly in the context of increasing water scarcity and variability. The strategy includes measures to improve the management of groundwater resources and enhance the resilience of dependent ecosystems.
- National Biodiversity Strategy and Action Plan: Togo's National Biodiversity Strategy and Action Plan, adopted in 2016, aims to promote the conservation and sustainable use of biodiversity in Togo. The plan includes measures to protect wetlands and other dependent ecosystems, as well as endangered species.

The following government agencies are responsible for implementing these policies and strategies:

- Ministry of Water and Sanitation
- National Water Resources Management Agency
- Ministry of Environment and Forest Resources
- National Biodiversity Coordination Committee.

Uganda

The economy of Uganda heavily depends on natural resources, including its groundwater resources. Building climate resilience of the key sectors and reducing disaster risks are key to its economic development. The third National Development Plan 2020/21-2024/25 (NDP III) of Uganda and Uganda Vision 2040 emphasizes that climate change negatively affects most key economic sectors, particularly the agriculture, forestry and energy sectors. The National Climate Change Policy (NCCP) identifies adaptation, mitigation, monitoring, and research as priority areas towards 'a climate-resilient and low-carbon development path for sustainable development in Uganda'. Multiple policies and legislations refer to groundwater management and utilization, including the Water Statute (1995), National Water Policy (1999), National Environment Statute (1995), Water Abstraction, Water Sources Protection Guidelines (2013), and Wastewater Discharge Regulations (1998). However, a dedicated policy on groundwater is only under consideration and development lately.

Nile Basin Initiative (NBI) and Lake Victoria Basin Commission (LVBC): Regionally, Uganda is a Member State of the two intergovernmental organizations for water resources management. The 10-year Strategy (2017-2027) of NBI identifies six strategic objectives covering areas of sustainable use, monitoring and protection of groundwater resources. One of the key strategic directions is enhancing sustainable and conjunctive use of groundwater and surface water. Key development objective under the LVBC Strategic Plan (2016-2020) was to promote and facilitate the implementation of the integrated water resources management and development in the Lake Victoria Basin, including fostering and facilitating the development and implementation of sustainable surface and groundwater resources development and management strategies.

Uganda Vision 2040 recognizes that there is still a poor understanding of climate change and variability in Uganda and hence inadequate adaptation and mitigation measures in the country. Over the Vision 2040 period, the Uganda government promises to develop appropriate adaptation and mitigation strategies in all sectors to increase the country's resilience to the impact of climate change, including knowledge and information sharing, policy and organizational structure, and capacity building.

Water and Environment, The Ministry of Water and Environment, is the lead institution in implementing the Natural Resources, Environment, Climate Change, Land and Water Management Programme. The interventions of this programme are critical to the reduction of disaster losses, achievement of increased household incomes and improvement of quality of life of the population as envisaged in the overall NDP III goal. The programme is delivered through three sub-programme, namely: 1) water management, 2) environment and natural resources, and 3) land management. The intermediate outcomes of the Water Management sub-programme include improved catchment-based water resources management (indicated

by the percentage of planned Catchment Management Plan interventions implemented and the frequency of water quantity updates), improved water quality monitoring and securing Uganda's interest in transboundary water resources.

Parish Development Model Uganda launched the Parish Development Model in 2022, which is a bottom-up approach for national development with planning, budgeting and delivery of public services at the lowest administrative level (i.e. parish). All interventions and projects are expected to follow the model. The proposed pilot case in Uganda helps to address at least three pillars of the Parish Development Model. These include Pillar 5 on parish-based management information system, Pillar 6 on governance and administration, and Pillar 7 on mindset change, community mobilization and cross-cutting issues).

8. Knowledge Management

Elaborate the "Knowledge Management Approach" for the project, including a budget, key deliverables and a timeline, and explain how it will contribute to the project's overall impact.

Due to the nature of the project, knowledge management is an integral part of each component. Throughout the project, G4DR will follow and learn from other relevant projects and initiatives identified and beyond, network with key institutions, and document best practices and results from case studies for dissemination to wider stakeholder groups. G4DR will follow a comprehensive knowledge management approach by collating information on relevant stakeholders, existing and new data, tools and methodologies, as well as innovative projects and initiatives on groundwater issues at different scales (continent, basins, countries). This approach will also seek to foster partnerships, networking and collaborations among agencies and organizations working in the field of groundwater resources, environment, natural resources, especially with regards to regional knowledge for pilot case studies. Some key institutions will include international and regional financing institutions such as AMCOW, ANBO, RBOs, RECs, AfDB, WWE, IUCN.

Table 8. List of project deliverables.

#	Description of Deliverable	Component No	Lead Partner	Due Date (month)	Target Audience	Budget (USD)
D1.1	Resources mobilization strategy and business plan, based on a partner mapping exercise	1	AMCOW	12	AMCOW, development partners, AGNs	50,000

D1.2	Groundwater Planning Assessment Framework (GPAF)	1	AMCOW	15	Continental and national-scale decision makers (e.g., AU, AMCOW, ministries of water, energy, infrastructure and agriculture), global and regional donors and organizations (e.g., ERCs, RBOs, Development agencies, World Bank, AfDB)	99,765
D1.3	Policy Guidelines	1	AMCOW	25	Continental and national-scale decision makers (e.g., AU, AMCOW, ministries of water, energy, infrastructure and agriculture), global and regional donors and organizations (e.g., ERCs, RBOs, Development agencies, World Bank, AfDB)	75,000
D1.4	Stakeholder Engagement Report	1	AMCOW	36	Continental and national-scale decision makers (e.g., AU, AMCOW, ministries of water, energy, infrastructure and agriculture), global and regional donors and organizations (e.g., ERCs, RBOs, Development agencies, World Bank, AfDB)	75,000
D1.5	Africa-wide Groundwater Strategy & Coordinating Framework	1	AMCOW	18	AMCOW, AU, RECs & COEs, RBOs, member states	50,000
D2.1	Inventory of groundwater data in Africa	2	IIASA	12	Continental and national-scale decision makers (e.g., AU, AMCOW, ministries of water, energy, infrastructure and agriculture), global and regional donors and organizations (e.g., ERCs, RBOs, Development agencies, World Bank, AfDB)	50,000

D2.2	Visualization tool to support exploration of groundwater-related risks and opportunities in Africa	2	IIASA	24	Continental and national-scale decision makers (e.g., AU, AMCOW, ministries of water, energy, infrastructure and agriculture), global and regional donors and organizations (e.g., ERCs, RBOs, Development agencies, World Bank, AfDB)	82,500
D2.3	Training 1 on data processing and analysis with training material openly and freely available	2	IIASA	18	Regional experts selected by AMCOW, RECs, & RBOs	10,625
D2.4	Training 2 on introduction to modeling with training material openly and freely available	2	IIASA	30	Local experts selected by AMCOW, RECs & RBOs	10,625
D2.5	Training 3 on advanced modeling with training material openly and freely available	2	IIASA	36	Regional experts selected by AMCOW, RECs, & RBOs	10,625
D2.6	Training 4 on groundwater monitoring and governance with training material openly and freely available	2	IWMI	42	Regional experts selected by AMCOW, RECs & RBOs	10,625
D2.7	GESI Water and livelihoods assessment report	2	IWMI	6	Continental and national-scale decision makers (e.g., AU, AMCOW, ministries of water, energy, infrastructure and agriculture), global and regional donors and organizations (e.g., ERCs, RBOs, Development agencies, World Bank, AfDB)	2,500

D3.1	Report on Groundwater Diagnostic Analysis (GDA) of the Upper Nile Management Zone in Uganda	3	IIASA	30	National decision makers in Uganda (e.g., Ministry of Water and Environment, Ministry of Agriculture), groundwater users in the Upper Nile Management Zone (e.g., farmers, water supply utilities, mining companies), global and regional donors and organizations (e.g., AMCOW, ADA, NBI, LVBC, IGAD, EAC, World Bank, AfDB)	87,500
D3.2	Report on Groundwater Strategic Action Plan (SAP) of the Upper Nile Management Zone in Uganda	3	IIASA	45	National decision makers in Uganda (e.g., Ministry of Water and Environment, Ministry of Agriculture), groundwater users in the Upper Nile Management Zone (e.g., farmers, water supply utilities, mining companies), global and regional donors and organizations (e.g., AMCOW, ADA, NBI, LVBC, IGAD, EAC, World Bank, AfDB)	87,500
D3.3	Gender and Water Assessment Report for Uganda	3	IWMI	12	National decision makers in Uganda (e.g., Ministry of Water and Environment, Ministry of Agriculture), groundwater users in the Upper Nile Management Zone (e.g., farmers, water supply utilities, mining companies), global and regional donors and organizations (e.g., AMCOW, ADA, NBI, LVBC, IGAD, EAC, World Bank, AfDB)	25,000

D3.4	Gender and Water Assessment Report for Transboundary Shire Aquifer system.	3	IWMI	12	National Decision-makers in Malawi (e.g., Ministry of Water Resources) and Mozambique (e.g., DGNRH), groundwater users, SADC-GMI, AMCOW, regional donors	25,000
D3.5	Report on co-design of harmonized groundwater monitoring network for the Shire Transboundary aquifer system	3	IWMI	12	National Decision-makers in Malawi (e.g., Ministry of Water Resources) and Mozambique (e.g., DGNRH), groundwater users, SADC-GMI, AMCOW, regional donors	62,500
D3.6	Groundwater quality field report for the Shire River - Analysis of spatial and temporal variability in water quality in the Shire River Basin.	3	IWMI	45	National Decision-makers in Malawi (e.g., Ministry of Water Resources) and Mozambique (e.g., DGNRH), groundwater users, SADC-GMI, AMCOW, regional donors	50,000
D3.7	Report on field instrumentation and Analysis of spatial and temporal variability in groundwater levels in the Shire transboundary aquifer system.	3	IWMI	40	National Decision-makers in Malawi (e.g., Ministry of Water Resources) and Mozambique (e.g., DGNRH), groundwater users, SADC-GMI, AMCOW, regional donors	50,000
D3.8	Gender and Water Assessment Report for the shared Mono Basin	3	IWMI	12	MBA, national decision-makers in Benin (e.g., Ministry of Water and Mining) and Togo (e.g., Ministry of Village Hydraulics), groundwater users, OSS, AMCOW, regional donors	25,000

D3.9	Report on co-design of harmonized groundwater monitoring network for the Mono River Basin	3	IWMI	12	MBA, national decision-makers in Benin (e.g., Ministry of Water and Mining) and Togo (e.g., Ministry of Village Hydraulics), groundwater users, OSS, AMCOW, regional donors	62,500
D3.10	Groundwater quality field report for the Mono River Basin -analysis of spatial and temporal variability in water quality in the Mono River Basin	3	IWMI	45	MBA, national decision-makers in Benin (e.g., Ministry of Water and Mining) and Togo (e.g., Ministry of Village Hydraulics), groundwater users, OSS, AMCOW, regional donors	50,000
D3.11	Report on field instrumentation, strategic well rehabilitation to reduce flood risk to drinking water supplies, and Analysis of spatial and temporal variability in groundwater levels in the Mono River Basin.	3	IWMI	40	MBA, national decision-makers in Benin (e.g., Ministry of Water and Mining) and Togo (e.g., Ministry of Village Hydraulics), groundwater users, OSS, AMCOW, regional donors	50,000
3.12	Data Sharing Platforms	3	IWMI	36	MBA, National decision-makers in Malawi (e.g., Ministry of Water Resources) and Mozambique (e.g., DGNRH), national decision-makers in Benin (e.g., Ministry of Water and Mining) and Togo (e.g., Ministry of Village Hydraulics), groundwater users, OSS, SADC-GMI AMCOW, regional donors	35,750

3.13	Study Tours	3	SADC-GMI	42	MBA, National decision-makers in Malawi (e.g., Ministry of Water Resources) and Mozambique (e.g., DGNRH), national decision-makers in Benin (e.g., Ministry of Water and Mining) and Togo (e.g., Ministry of Village Hydraulics), groundwater users, OSS, SADC-GMI AMCOW, regional donors	32,500
D3.14	Synthesis report on pilot experiences - summarizing the results or lesson learning from the three case studies and potential for upscaling to other regions in Africa.	3	IWMI	47	Continental and national-scale decision makers (e.g., AU, AMCOW, ministries of water, energy, infrastructure and agriculture), global and regional donors and organizations (e.g., ERCs, RBOs, Development agencies, World Bank, AfDB)	31,750
D4.1	Youth Forum Action Plan	4	IWMI	12	Continental and national-scale decision makers (e.g., AU, AMCOW, ministries of water, energy, infrastructure and agriculture), global and regional donors and organizations (e.g., ERCs, RBOs, Development agencies, World Bank, AfDB)	83,500
D4.2	Consolidated Youth Forum Implementation Plan	4	IWMI	24	Continental and national-scale decision makers (e.g., AU, AMCOW, ministries of water, energy, infrastructure and agriculture), global and regional donors and organizations (e.g., ERCs, RBOs, Development agencies, World Bank, AfDB)	65,250

D5.1	Communications Plan and Knowledge Management Plan	5	IWMI	15	GEF, Continental and national-scale decision makers (e.g., AU, AMCOW, ministries of water, energy, infrastructure and agriculture), global and regional donors and organizations (e.g., ERCs, RBOs, Development agencies, World Bank, AfDB)	162,500
D5.2	Gender-Responsive Monitoring System	5	IWMI	12	GEF, Continental and national-scale decision makers (e.g., AU, AMCOW, ministries of water, energy, infrastructure and agriculture), global and regional donors and organizations (e.g., ERCs, RBOs, Development agencies, World Bank, AfDB)	105,300

Note: 1% of the overall project budget is allocated to supporting **IW:LEARN** initiatives and activities. These resources are included under several lines of table 8 and clearly tagged in the project budget.

In addition, efforts will be undertaken to make knowledge management activities gender-sensitive. G4DR will ensure that women and men have equal access to the knowledge captured and shared. It also includes gender-sensitive language in publications, photos showing both women and men (if applicable), and avoiding the presentation of stereotypes.

A strong communication and outreach strategy will be developed to raise national, regional and global awareness on the proposed project and its accomplishments. The Communications and Knowledge Management Specialist will lead the development of the communication strategy and support throughout the implementation phase working and targeting all groups that the project works with in the realization of its objectives, including: government agencies, river basin organizations, AMCOW, GEF and project beneficiaries. The Communications and Outreach strategy and implementation plan will be designed to:

- Enhance the impact of project activities; Provide access to information on project-related activities;
- Encourage local feedback from beneficiaries and ensure appropriate mechanisms are established for beneficiary reporting;
- Encourage community participation and ownership of project from inception to completion and beyond; Support knowledge sharing within and across river basin organizations and governments.

A key component of the communication and outreach strategy is to develop and strengthen the avenues where both internal and external communications can be accelerated and contribute to highlighting achievements, carrying out advocacy interventions, and conveying to the media and beneficiaries the value of groundwater protection to underpin water security and adaptation planning and investment in Africa.

A variety of digital and print communication materials will be generated in multiple languages to ensure that all the relevant stakeholders in Africa are informed and engaged in the activities of the project with the final objective of positioning the G4DR as a driver of transformational change within the African continent and beyond. The impacts of the communication strategy and its materials will be closely monitored in order to adapt them regularly and maximize the impact in each country.

The Communications and Outreach Strategy will be guided by IWMI's broader communications strategy and approach which aims to connect and communicate global and regional trends and opportunities for sustainable management of water resources and to develop impactful communication products to expand the awareness of improved water management at the local, regional and global level. IWMI will leverage resources from our broader Communications and Knowledge management team to promote G4DR project successes and outcomes at multiple regional and international platforms and dialogue events.

Furthermore, the project will prioritize due participation in the actions identified under the IW:LEARN Supporting Portfolio Coordination Within and Beyond the International Waters Focal Area, such as regional training workshops, twinning activities, and cross sharing of data and good practices. To this end, 1% of the GEF IW grant will be used to support active engagement and participation of the project's stakeholders in learning activities, including global and regional events and the production and dissemination of experience notes. These will be further shared through the IW:LEARN, eventually benefitting an audience that goes beyond the project partners.

9. Monitoring and Evaluation

Describe the budgeted M and E plan

The project results, as outlined in the project results framework (Annex A1), will be monitored regularly, reported annually and assessed during project implementation to ensure the project effectively achieves these results. Monitoring and evaluation activities will follow FAO and GEF's policies and guidelines for monitoring and evaluation. The M&E system will also facilitate learning, replication of the project's results and lessons which will feed the project's knowledge management strategy.

Monitoring Arrangements

Project oversight and supervision will be carried out by the Budget Holder (BH) with the support of the Project Task Force (PTF), Lead Technical Officer (LTO) and Funding Liaison Officer (FLO) and relevant technical units in FAO headquarters. Oversight will ensure that: (i) project outputs are produced in accordance with the project results framework and leading to the achievement of project outcomes; (ii) project outcomes are leading to the achievement of the project objective; (iii) risks are continuously

identified and monitored and appropriate mitigation strategies are applied; and (iv) agreed project global environmental benefits are being delivered.

The FAO-GEF Coordination Unit and HQ Technical units will provide oversight of GEF financed activities, outputs and outcomes largely through six-month project progress reports (PPRs) and the annual Project Implementation Reports (PIRs), periodic backstopping and supervision missions.

Day-to-day project monitoring will be carried out by the Project Management Unit. Project performance will be monitored using the project results matrix, including indicators (baseline and targets) and annual work plans and budgets. At inception phase, the results matrix will be reviewed to finalize the identification of i) outputs ii) indicators iii) targets and iv) any missing baseline information.

A detailed M&E plan, which builds on the results matrix and defines specific requirements for each indicator (data collection methods, frequency, responsibilities for data collection and analysis, etc) will also be developed during project inception by the PMU M&E.

Table 9. Monitoring and evaluation plan.

GEF requirements in the M&E plan	Primary responsibility	Estimated cost (USD) attributable to GEF funds	Time frame
Inception workshop (combined with 1st PSC meeting)	CTA, AMCOW, National Implementation Partners, IIASA, Financial Support Officers, Project Steering Committee (PSC), and FAO.	See cost associated to the PSCs below	Within two months of project document signature
Project inception report	Project Team, AMCOW, IIASA, and FAO.	Time of International Monitoring and Evaluation Specialist and Project team.	Within one month of inception workshop
Standard FAO monitoring and reporting requirements	FAO	FAO fees.	Quarterly
Risk management	CTA and FAO	Time of the CTA and FAO fees.	Quarterly
Project Progress Report (PPR)	Oversight by CTA, Project team, AMCOW and IIASA	Time of International Monitoring and Evaluation Specialist, Project team and FAO fees.	Biannually

Monitoring of indicators in project results framework	Oversight by CTA, Project team, AMCOW and IIASA	Time of International Monitoring and Evaluation Specialist, International stakeholder engagement specialist, Project team and FAO fees.	Annually before PIR
Annual Project Implementation Review Reports (PIR)	Oversight by CTA, Project team, AMCOW and IIASA	Time of the CTA, International Monitoring and Evaluation Specialist, International stakeholder engagement specialist, Project team and FAO fees.	Annually
Lessons learned and knowledge generation	Project Team, AMCOW and IIASA	Time of the Project team	Annually
Project Steering Committee Meetings	CTA, AMCOW, National Implementation Partners, IIASA, Financial Support Officers, Project Steering Committee (PSC), and FAO.	Time of the Project team Estimated PSC associated costs for contracts, Project Steering Committees, Validations Meetings, inception and final meetings, and travels. = USD 40,000 Associated costs to travels: USD30,000	Annually
Mid-Term Review (MTR)	? Project Management unit ? FAO SLC ? FAO-GEF Unit	USD 50,000	At mid-point of project implementation.
Terminal Evaluation (TE)	FAO Office of Evaluation (OED) managed	External consultancy, including travel costs with FAO staff time (including OED with FAO-GEF Coordination Unit input) and travel costs will be financed from GEF fees = USD 75,000	To be launched six months before final review meeting

Terminal report	TPC, FAOSLC as BH (with the support of the FAO LTO and the FAO-GEF Unit); M&E Expert, with inputs from UWI-FFA(Bursary)	USD 7,000 , with additional IWMI, AMCOW, IIASA and FAO staff time as in-kind co-financing.	Two months before the project completion date
Spot-Checks	FAO	External consultancy, including travel costs with FAO staff time (including OED with FAO-GEF Coordination Unit input) and travel costs will be financed from GEF fees = USD 17,664	
Estimated costs of combined time of International Monitoring and Evaluation Specialist, International stakeholder engagement specialist, International consultant to develop communications plan and knowledge management plan on M&E activities		USD 53,000	
TOTAL COST		USD 272,664	

Monitoring and Reporting

In compliance with FAO and GEF M&E policies and requirements, the Operational Partner/PMU, in consultation with the PSC and PTF will prepare the following i) Project inception report; (ii) Annual Work Plan and Budget (AWP/B); (iii) Project Progress Reports (PPRs); (iv) annual Project Implementation Review (PIR); (v) Technical Reports; (vi) co-financing reports; and (vii) Terminal Report. In addition, the Core Indicators included in indicate annex will be used to monitor Global Environmental benefits / adaptation benefits (specify as appropriate) and updated regularly by the OP/PMU.

Project Inception Report. A project inception workshop will be held within two months of project start date and signature of relevant agreements with partners. During this workshop the following will be reviewed and agreed:

- a. the proposed implementation arrangement, the roles and responsibilities of each stakeholder and project partners;
- b. an update of any changed external conditions that may affect project implementation;

- c. the results framework, the SMART indicators and targets, the means of verification, and monitoring plan;
- d. the responsibilities for monitoring the various project plans and strategies, including the risk matrix, the Environmental and Social safeguards and Management Plan, the gender strategy, the knowledge management strategy, and other relevant strategies;
- e. finalize the preparation of the first year AWP/B, the financial reporting and audit procedures;
- f. schedule the RPSC meetings;
- g. prepare a detailed first year AWP/B,
- h. Terms of reference of key project staff.

The OP/PMU will draft the inception report based on the agreement reached during the workshop and circulate among PSC members, BH, LTO and FLO for review within one month. The final report will be cleared by the FAO BH, LTO and the FAO GEF Coordination Unit and uploaded in FAO's Field Program Management Information System (FPMIS) by the BH.

Results-based Annual Work Plan and Budget (AWP/B). The draft of the first AWP/B will be prepared by the OP/PMU in consultation with national project counterparts and the FAO Project Task Force and reviewed at the project Inception Workshop. The Inception Workshop inputs will be incorporated and subsequently, the OP/PMU will submit a final draft AWP/B to the RPSC within the next day for review and endorsement at the RPSC meeting. For subsequent AWP/B, the PMU will organize a project progress review and planning meeting for its progress review and adaptive management. Once RPSC comments have been incorporated, the OP/PMU will submit the AWP/B to the BH for non-objection, LTO and the FAO GEF Coordination Unit for comments and for clearance by BH and LTO prior to uploading in FPMIS by the BH. The AWP/B must be linked to the project's Results Framework indicators to ensure that the project's work and activities are contributing to the achievement of the indicators. The AWP/B should include detailed activities to be implemented to achieve the project outputs and output targets and divided into monthly timeframes and targets and milestone dates for output indicators to be achieved during the year. A detailed project budget for the activities to be implemented during the year should also be included together with all monitoring and supervision activities required during the year. The annual procurement plan is also included or attached to AWP/B and to be approved by RPSC. The AWP/B should be approved by the Project Steering Committee, and uploaded on the FPMIS by the BH.

Project Progress Reports (PPR): The PPRs are used to identify constraints, problems or bottlenecks that impede timely implementation and to take appropriate remedial action. PPRs will be prepared based on the systematic monitoring of output and outcome indicators identified in the Project Results Framework Annex A1, AWP/B and M&E Plan. Each semester the CTA will prepare a draft PPR, will collect and consolidate any comments from the FAO PTF. The CTA will submit the final PPRs to the FAO Regional Office for Africa every six months, prior to 31 July (covering the period between January and June) and before 31 January (covering the period between July and December). The July-December report should be accompanied by the updated AWP/B for the following Project Year (PY) for review and no-objection by

the FAO PTF. The Budget Holder has the responsibility to coordinate the preparation and finalization of the PPR, in consultation with the PMU, LTO and the FLO. After LTO, BH and FLO clearance, the FLO will ensure that project progress reports are uploaded in FPMIS in a timely manner.

Annual Project Implementation Report (PIR): The PIR is a key self-assessment tool used by GEF Agencies for reporting every year on project implementation status. It helps to assess progress toward achieving the project objective and implementation progress and challenges, risks and actions that need to be taken. Under the lead of the BH, the CTA will prepare a consolidated annual PIR report covering the period July (the previous year) through June (current year) for each year of implementation, in collaboration with national project partners (including the GEF OFP), the Lead Technical Officer, and the FLO. The CTA will ensure that the indicators included in the project results framework are monitored annually in advance of the PIR submission and report these results in the draft PIR.

BH will be responsible for consolidating and submitting the PIR report to the FAO-GEF Coordination Unit for review by the date specified each year after each co-implementing agency's review for each respective output under their responsibilities (to be included for joint implementation only). FAO - GEF Funding Liaison Officer review PIRs and discuss the progress reported with BHs and LTOs as required. The BH will submit the final version of the PIR to the FAO-GEF Coordination Unit for final approval. The FAO-GEF Coordination Unit will then submit the PIR(s) to the GEF Secretariat as part of the Annual Monitoring Review of the FAO-GEF portfolio.

Technical Reports: Technical reports will be prepared as part of project outputs and to document and share project outcomes and lessons learned. The LTO will be responsible for ensuring appropriate technical review and clearance of technical reports. Copies of the technical reports will be distributed to project partners and the Project Steering Committee as appropriate.

Co-financing Reports: The OP/PMU will be responsible for tracking co-financing materialized against the confirmed amounts at project approval and reporting. The co-financing report, which covers the GEF fiscal year 1 July through 30 June, is to be submitted on or before 31 July and will be incorporated into the annual PIR. The co-financing report needs to include the activities that were financed by the contribution of the partners.

Tracking and reporting on results across the GEF 7 core indicators and sub-indicators: As of July 1, 2018, the GEF Secretariat requires FAO as a GEF Agency, in collaboration with recipient country governments, executing partners and other stakeholders to provide indicative, expected results across applicable core indicators and sub-indicators for all new GEF projects submitted for Approval. During the approval process of the (insert short project title) expected results against the relevant indicators and sub-indicators have been provided to the GEF Secretariat. Throughout the implementation period of the project, the OP/PMU, is required to track the project's progress in achieving these results across applicable core indicators and sub-indicators. At project mid-term and project completion stage, the project team in consultation with the PTF and the FAO-GEF CU are required to report achieved results against the core indicators and sub-indicators used at CEO Endorsement/ Approval.

Terminal Report: Within two months prior to the project's completion date, the CTA will submit to the PSC and FAO Representation a draft Terminal Report. The main purpose of the terminal report is to give

guidance to authorities (ministerial or senior government level) on the policy decisions required for the follow-up of the project, and to provide the donor with information on how the funds were utilized. Therefore, the terminal report is a concise account of the main products, results, conclusions and recommendations of the Project, without unnecessary background, narrative or technical details. The target readership consists of persons who are not necessarily technical specialists but who need to understand the policy implications of technical findings and needs for ensuring sustainability of project results. Work is assessed, lessons learned are summarized, and recommendations are expressed in terms of their application to the integrated landscape management in the three pilot sites, as well as in practical execution terms. This report will specifically include the findings of the final evaluation. A project evaluation meeting will be held to discuss the draft final report with the RPSC before completion by the Project Coordinator and approval by the BH, LTO, and FAO-GEF Coordination Unit.

Mid Term Review and Terminal Evaluation provisions

Mid-Term Review

An independent mid-term review (MTR) will be carried out at project mid-life in terms of expenditure and/or overall project duration, tentatively in the third quarter of project year 2026. The BH will arrange an independent MTR in consultation with the Project Steering Committee (PSC), the Project Management Unit (PMU), the lead technical officer (LTO) and the FAO-GEF Coordination Unit in FAO headquarters. The MTR will be conducted to review progress and effectiveness of implementation in terms of achieving project objective, outcomes and outputs. The MTR will allow mid-course corrective actions, if needed. The MTR will provide a systematic analysis of the information on project progress in the achievement of expected results against budget expenditures. It will refer to the project budget (see Annex A2) and the approved AWP/Bs. It will highlight replicable good practices and key issues faced during project implementation and will suggest mitigation actions to be discussed by the PSC, the LTO and FAO-GEF Coordination Unit.

The Mid-Term review will (i) assess the progress made towards achievement of planned results (ii) identify problems and make recommendations to redress the project (iii) highlight good practices, lessons learned and areas with the potential for upscaling.

To support the planning and conduct of the MTR, the FAO GEF CU has developed a guidance document **?The Guide for planning and conducting Mid-Term Reviews of FAO-GEF projects and programmes?.** The FAO-GEF CU will appoint an MTR focal point who will provide guidance on GEF specific requirements, quality assurance on the review process and overall backstopping support for the effective management of the exercise and for timely the submission of the MTR report to the GEF Secretariat.

After the completion of the Mid-Term Review, the BH will be responsible for the distribution of the MTR report at country level (including to the GEF OFP) and for the preparation of the Management Response within 4 weeks and share it with national partners, GEF OFP and the FAO-GEF CU. The BH will also send the updated core indicators used during the MTR to the FAO-GEF CU for their submission to the GEF Secretariat.

Terminal Evaluation

The GEF evaluation policy foresees that all Medium and Full-sized projects require a separate terminal evaluation. Such evaluation provides: i) accountability on results, processes, and performance ii) recommendations to improve the sustainability of the results achieved and iii) lessons learned as an evidence-base for decision-making to be shared with all stakeholders (government, execution agency, other national partners, the GEF and FAO) to improve the performance of future projects.

The Budget Holder will be responsible to contact OED within six months prior to the actual completion date (NTE date). OED will manage the decentralized independent terminal evaluation of this project and will be responsible for quality assurance. Independent external evaluators will conduct the terminal evaluation of the project considering the "GEF Guidelines for GEF Agencies in Conducting Terminal Evaluation for Full-sized Projects". FAO Office of Evaluation (OED) will be responsible for the quality assessment of the terminal evaluation report, including the GEF ratings.

Evaluation provisions, as outlined above, are conditional and subject to change in accordance with any future amendments to the FAO policy and GEF policy on evaluation.

After the completion of the terminal evaluation, the BH will be responsible to prepare the management response to the evaluation within 4 weeks and share it with national partners, GEF OFP, OED and the FAO-GEF CU. The BH will also send the updated core indicators used during the TE to the FAO-GEF CU for their submission to the GEF Secretariat.

The evaluations will also assess how the OPA implementation and partnership agreement influenced the achievement and sustainability of results while contributing to enhance capacities of the OP/s. In doing so, the evaluation will consider the brief guidance note and evaluation questions OED has developed in consultation with the OPIM unit.

Disclosure

The project will ensure transparency in the preparation, conduct, reporting and evaluation of its activities. This includes full disclosure of all non-confidential information, and consultation with major groups and representatives of local communities. The disclosure of information shall be ensured through posting on websites and dissemination of findings through knowledge products and events. Project reports will be broadly and freely shared, and findings and lessons learned made available.

10. Benefits

Describe the socioeconomic benefits to be delivered by the project at the national and local levels, as appropriate. How do these benefits translate in supporting the achievement of global environment benefits (GEF Trust Fund) or adaptation benefits (LDCF/SCCF)?

Socio-economic benefits

G4DR can deliver significant socioeconomic benefits to the whole African continent as well as to pilot countries, Benin, Malawi, Mozambique Togo and Uganda, at both the national and local levels. G4DR

aims to improve the groundwater knowledge base, enhance institutional and technical capacities related to groundwater planning, and engage with youth of all genders and social differences to increase awareness about groundwater. These will result in improved management of groundwater, leading to several socio-economic benefits in the mid- and long-terms such as increased agricultural productivity, improved access to safe and reliable water supply, enhanced livelihoods for rural communities, increased resilience to climatic and non-climatic shocks, and ultimately enhanced water security. These co-benefits are essential for achieving sustainable development in Africa and improving the well-being of the population. Benefits and co-benefits of the project will be monitored during project implementation and reported adequately:

- Increased agricultural productivity: Groundwater plays a critical role in agricultural production in many African countries, including Uganda, Malawi, and Mozambique. Improved groundwater management can enhance the availability of water for irrigation, leading to increased agricultural productivity and food security. A study conducted in Malawi found that improved access to groundwater resources led to increased crop yields and improved livelihoods for smallholder farmers (Tiwari et al., 2017). Similarly, a study conducted in Uganda found that access to groundwater for irrigation led to increased crop yields and income for farmers (Mwangi et al., 2018). Improved groundwater management is also critical for safeguarding crop yields, increased livestock productivity, and enhanced food security for local communities in the Mono River basin. According to a study conducted by Rabiou et al. (2018) in the Mono River basin, improved groundwater management can increase agricultural productivity by up to 100%, leading to increased incomes for farmers and improved livelihoods.
- Improved access to safe and reliable water supply: Groundwater is often the primary source of drinking water in rural areas of Africa. Improved groundwater management can ensure that groundwater resources are sustainable and provide safe and reliable water supply to communities. A study conducted in Mozambique found that improved groundwater management led to increased access to safe water supply and improved health outcomes (Chavane et al., 2020). Similarly, a study conducted in Uganda found that improved groundwater management can increase access to safe water supply and reduce the burden of waterborne diseases (Nalubega et al., 2019).
- Enhanced livelihoods for rural communities: Groundwater resources are often the lifeline for rural communities in Africa, providing water for domestic use, irrigation, and livestock watering. Improved groundwater management can enhance the sustainability of groundwater resources, leading to improved livelihoods for rural communities. A study conducted in Malawi found that access to groundwater resources led to improved livelihoods and reduced poverty for rural communities (Tiwari et al., 2017). Similarly, a study conducted in Mozambique found that improved groundwater management can enhance the resilience of rural communities to climate change and improve their livelihoods (Chavane et al., 2020).
- Another socio-economic benefit of improved groundwater management is the protection of wetlands, which play a vital role in regulating the hydrological cycle and providing habitat for a variety of aquatic species and, thereby, safeguarding also food security. Wetlands also provide important ecosystem services such as water purification, flood control, and carbon sequestration, all generating socio-economic benefits. According to a study in the Mono River basin conducted by Zoungwana et al. (2021), improved wetland management can lead to increased fish yields, which are an important source of protein for local communities in the Mono River basin.

- Furthermore, improved groundwater management can lead to the development of small-scale industries, such as agro-processing and craft production, which can create employment opportunities for local communities. This can lead to increased income and improved standards of living for households. According to a study conducted by Assamoi et al. (2020) in the Mono River basin, improved water management can stimulate the development of small-scale industries, leading to increased income and employment opportunities for local communities.

Supporting GEF TF benefits and adaptation

Improved groundwater management can support the achievement of biodiversity conservation, reduced greenhouse gas emissions, the reversal of land degradation, and improved climate adaptation in Africa. Here is how the socioeconomic benefits translate into these areas:

- Biodiversity conservation: Improved groundwater management can reduce the pressure on surface water resources, leading to the conservation of freshwater ecosystems and the biodiversity they support. This can help to maintain healthy and resilient ecosystems that support a variety of species. A study conducted in Mozambique found that sustainable groundwater use can support the conservation of wetland ecosystems and the biodiversity they support (Chavane et al., 2020).
- Reduced greenhouse gas emissions: Groundwater pumping is a significant source of energy consumption and greenhouse gas emissions. Improved groundwater management can reduce energy consumption and greenhouse gas emissions by promoting the use of efficient irrigation technologies and reducing water losses. A study conducted in Malawi found that improved groundwater management can reduce energy consumption and greenhouse gas emissions by promoting the use of solar-powered pumps and efficient irrigation practices (Tiwari et al., 2017).
- Reversal of land degradation: Improved groundwater management can support the reversal of land degradation by providing water for soil conservation and land restoration activities. This can help to improve soil fertility and reduce erosion, leading to improved land productivity and increased carbon sequestration. A study conducted in Uganda found that improved groundwater management can support the reversal of land degradation by providing water for reforestation and soil conservation activities (Mwangi et al., 2018).
- Improved climate adaptation: Groundwater resources can play a critical role in climate adaptation by providing water for drought and flood management. Improved groundwater management can enhance the resilience of communities to climate change by ensuring the availability of water for various uses, including agriculture, domestic use, and livestock watering. A study conducted in Malawi found that improved groundwater management can enhance the resilience of rural communities to climate change by providing water for various uses and reducing the vulnerability of communities to climate-related risks (Tiwari et al., 2017).

By systematically improving groundwater management, the project will support the achievement of biodiversity conservation, reduced greenhouse gas emissions, the reversal of land degradation, and improved climate adaptation in Africa. These benefits highlight the multiple co-benefits that can be achieved through sustainable groundwater management, and they underscore the critical role of groundwater resources in achieving sustainable development.

Full and productive employment

Improved groundwater management can promote full and productive employment and decent work in rural areas of Africa by providing a reliable and sustainable source of water for agricultural activities, leading to increased productivity and income generation. Here is how improved groundwater management can support the progressive realization of the right to Decent Rural Employment:

- **Increased agricultural productivity:** Improved groundwater management can provide reliable and sustainable water sources for irrigation, leading to increased agricultural productivity and higher yields. This can help to generate employment opportunities and increase incomes for rural households, including women and youth, who are often disadvantaged in accessing Decent Rural Employment. A study conducted in Malawi found that improved groundwater management can increase agricultural productivity and support the creation of employment opportunities in rural areas (Tiwari et al., 2017).
- **Diversification of livelihoods:** Improved groundwater management can support the diversification of livelihoods by enabling the cultivation of a variety of crops and the establishment of small-scale businesses that rely on water. This can help to reduce the reliance on rain-fed agriculture and provide alternative sources of income for rural households, including women and youth. A study conducted in Uganda found that improved groundwater management can support the diversification of livelihoods and the creation of alternative sources of income for rural households (Mwangi et al., 2018).
- **Increased access to water for domestic use:** Improved groundwater management can also provide access to water for domestic use, leading to improved health outcomes and reduced labor burdens for women and girls who are often responsible for water collection. This can free up time for other productive activities, such as education and income generation. A study conducted in Mozambique found that improved groundwater management can support the provision of water for domestic use and reduce the labor burden for women and girls (Chavane et al., 2020).

Improved groundwater management supports the progressive realization of the right to Decent Rural Employment ? as recognized by the International Labour Organization (ILO) ? by increasing agricultural productivity, supporting the diversification of livelihoods, and providing access to water for domestic use. These benefits highlight the critical role of groundwater resources in promoting full and productive employment and decent work in rural areas, which are essential for achieving sustainable development. In addition, groundwater scarcity can limit inclusiveness and empowerment of women. The last also positive impacts the sustainability of local groundwater management (Nigussie L. et al, 2018). As a result, an additional benefit of improved local groundwater is women inclusion and empowerment when considered in policy-making with attention not to increase their workload.

The project will ensure the inclusion of women and youth by taking a Gender Transformative Approach throughout the components to map key systemic and structural barriers to more inclusive interventions (see Annex N). In particular a Gender Equality and Social Inclusion (GESI) groundwater and livelihood assessment in Africa will be done in its component 2, and a gender and water assessment for each of the pilot aquifers studied under component 3. The project will adopt a key focus on youth inclusion, by engaging with the Youth Forum (component 4) to identify and pilot incentives and role models for youth, including females to become part of networks involved in groundwater for advancing resilience in Africa.

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11. Environmental and Social Safeguard (ESS) Risks

Provide information on the identified environmental and social risks and potential impacts associated with the project/program based on your organization's ESS systems and procedures

Overall Project/Program Risk Classification *

PIF	CEO Endorsement/Approval	MTR	TE
Low	Medium/Moderate		

Measures to address identified risks and impacts

Elaborate on the types and risk classifications/ratings of any identified environmental and social risks and impacts (considering the GEF ESS Minimum Standards) and any measures undertaken as well as planned management measures to address these risks during implementation.

The project as classified a LOW risk during the PIF stage. The ESS Risk Identification ? Screening Checklist attached still reflects this rating.

At the end of the PPG phase, the internal FAO's committee requested to reclassify to MODERATE, based on cumulative risk and mainly social risks related to the project foreseeing effects on Indigenous Peoples (ESS9), and any risks related to Decent Work (ESS7) in case the project employs local communities.

In FAO internal project cycle, the reclassification for this causes does not require preparing a new ESS Risk Identification ? Screening Checklist, nor the issuing a new certificate. However, the FAO committee requested modifications to the project document as detailed below:

1. Language and actions to prevent negative impacts on indigenous people have been included in the resubmission.
2. A new and updated version of the **FAO's Grievance Redress Mechanism** has been attached as part of the UPDATED-Dec23 Annex L-Stakeholder Engagement Matrix and Grievance Redress Mechanism. This is available both the roadmap of the CEO ER and as part of the FA Project Document attached in PDF.

Supporting Documents

Upload available ESS supporting documents.

Title	Module	Submitted
FAO ES Risk Identification ? Screening Checklist- G4DR	Project PIF ESS	
FAO Risk Certificate- G4DR	Project PIF ESS	

ANNEX A: PROJECT RESULTS FRAMEWORK (either copy and paste here the framework from the Agency document, or provide reference to the page in the project document where the framework could be found).

Results chain	Indicators	Baseline	Mid-term target	Final target	Means of verification	Assumptions	Responsible party
Objective: To enhance water security and resilience in Africa by unlocking the potential of sustainable groundwater development and protection.							
Core indicator 4	Area of landscapes under improved practices (hectares; excluding protected areas)	0	2,000	26,000	Executing partners reporting	See project theory of change	PMU with inputs from all executing partners
Core indicator 4.3	Area of landscapes under sustainable land management in production systems (in ha)	0	2,000	26,000	Executing partners reporting		
Core indicator 7	Number of shared groundwater ecosystems under new or improved cooperative management	0	0	3 Shire Valley Alluvial Aquifer Mono Global (pan-african)	Executing partners reporting		

Results chain	Indicators	Baseline	Mid-term target	Final target	Means of verification	Assumptions	Responsible party
Core indicator 7.1	Provision of analysis and knowledge products, and impacts on formulation of action programs in participating countries	Shire Valley Alluvial Aquifer: 4 Mono: 1 Global (pan-african): 1	Shire Valley Alluvial Aquifer: 4 Mono: 2 Global (pan-african): 2	Shire Valley Alluvial Aquifer: 4 Mono: 3 Global (pan-african): 3	Executing partners reporting		
Core indicator 7.2	Level of Regional Legal Agreements and regional Management Institutions to support its implementation	Shire Valley Alluvial Aquifer: 2 Mono: 1 Global (pan-african): 1	Shire Valley Alluvial Aquifer: 2 Mono: 2 Global (pan-african): 2	Shire Valley Alluvial Aquifer: 3 Mono: 3 Global (pan-african): 3	Executing partners reporting		
Core indicator 7.3	Level of National/Local reforms and active participation of national and regional stakeholders across relevant sectors	Shire Valley Alluvial Aquifer: 2 Mono: 2 Global (pan-african): 1	Shire Valley Alluvial Aquifer: 2 Mono: 2 Global (pan-african): 2	Shire Valley Alluvial Aquifer: 4 Mono: 3 Global (pan-african): 3	Executing partners reporting		
Core indicator 7.4	Level of engagement in IWLEARN through participation and delivery of key products	Shire Valley Alluvial Aquifer: 1 Mono: 1 Global (pan-african): 1	Shire Valley Alluvial Aquifer: 2 Mono: 2 Global (pan-african): 2	Shire Valley Alluvial Aquifer: 4 Mono: 4 Global (pan-african): 4	Review of IW:Learn activities		

Results chain	Indicators	Baseline	Mid-term target	Final target	Means of verification	Assumptions	Responsible party
Core indicator 11	Direct beneficiaries	0	0	34,200 total 40% women 60% men	Executing partner reporting		
Component 1 Strategic Planning: Supporting the African Ministers' Council on Water (AMCOW), through their Pan-African Groundwater Program (APAGroP), to strengthen planning and investment that incorporates groundwater.							
<u>Outcome 1.1:</u> AMCOW sustained and strengthened in its mandate to support Regional Economic Communities (RECs), River Basins Organizations (RBOs) & Member States (MSs) in achieving GW-based water security and resilience	<i>Intergovernmental and financial support for AMCOW secured.</i> <i>Support of GW-focused investments documented.</i>	<i>AMCOW's capacity to guide pan-African groundwater planning remains limited.</i> <i>Investments in GW-focused initiatives limited.</i>	<i>AMCOW support continued.</i>	<i>Commitment by key countries to continue sustaining AMCOW documented.</i>	<i>Minutes of AMCOW meetings.</i>	<i>Project development strengthens political commitment to transboundary cooperation</i>	<i>PMU, IWMI</i>

Results chain	Indicators	Baseline	Mid-term target	Final target	Means of verification	Assumptions	Responsible party
Output 1.1.1 Sustained and strengthened AMCOW Groundwater Function as an anchor institution for APAGroP and G4DR objectives	<i>Continued support of regional gender and ethnic minority balanced AMCOW confirmed and operational.</i>		<i>AMCOW support continued.</i>	<i>Countries continue to actively support AMCOW</i>			
<u>Outcome 1.2:</u> Greater resilience to shocks through increased capacity and use of tools to assess groundwater quantity and quality	<i>Number of capacity building events held and number of assessments conducted with newly provided tools and implemented in partnership with regional centers of excellence and their networks to ensure sustainable capacity improvements.</i>	<i>Land and water administrators relevant for groundwater extraction and recharge lack experience in and tools for conducting transboundary assessments.</i>	<i>2 knowledge sharing events held.</i>	<i>4 knowledge sharing events held, 1 GW assessment framework, 1 methodological guideline, 1 diagnostic study of gender-responsiveness of water policy framework</i>	<i>Knowledge sharing event reports.</i>	<i>Project management able to raise interest of targeted groups</i>	<i>PMU, IWMI</i>

Results chain	Indicators	Baseline	Mid-term target	Final target	Means of verification	Assumptions	Responsible party
Output 1.2.1 Knowledge and lesson sharing among the Basins & other key stakeholders (e.g., RECs). Application of framework to gauge progress toward incorporating groundwater, to be shared with AMCOW and the African Union Commission (AUC) as part of Water and Sanitation Sector Monitoring (WASSMO) process	<i>Number of knowledge sharing events held in partnership with regional centers of excellence and their networks to ensure sustainable capacity improvements.</i> <i>Level of gender responsiveness to the content of the knowledge sharing events</i>	<i>Regional knowledge exchange limited and lacking focus on transboundary aquifer management.</i> <i>Generally gender blind knowledge sharing related to groundwater</i>					
<u>Outcome 1.3:</u> Environments that enable & support management of groundwater opportunity and risk	<i>Policy guidelines on groundwater use and management endorsed</i>	<i>Countries ? actions lack strategic vision and transboundary coordination.</i>	<i>Policy guidelines being drafted based on scientific evidence and shared vision.</i>	<i>Policy guidelines submitted for signature</i>	<i>Documentation proving submission</i>	<i>Prevailing policy environment responsive to scientific evidence.</i>	<i>PMU, IWMI</i>

Results chain	Indicators	Baseline	Mid-term target	Final target	Means of verification	Assumptions	Responsible party
Output 1.3.1: Adoption & application of policy guidelines on groundwater use and management, co-developed with multisectoral actors	<i>by relevant agencies.</i>	<i>Lack of joint strategies for transboundary aquifer management.</i>		<i>at Minister level.</i>		<i>Project development strengthens political commitment to transboundary cooperation.</i>	
<u>Outcome: 1.4:</u> Coordinated multi-scale approach to groundwater planning in Africa	<i>Groundwater strategy and framework approved by relevant agencies and support by regional</i>	<i>Lack of regional groundwater use and management strategy.</i>	<i>Groundwater strategy and framework drafted and support documented by</i>	<i>Groundwater strategy and framework submitted for signature by at least one</i>	<i>Documentation proving submission.</i>	<i>Project development strengthens political commitment to transboundary</i>	<i>PMU, IWMI</i>

[illegible]

Results chain	Indicators	Baseline	Mid-term target	Final target	Means of verification	Assumptions	Responsible party
<p><u>Outcome 2.1:</u> More informed decision making on groundwater-related risks and opportunities under present and future climate and development scenarios</p>	<p><i>Analysis endorsed by the countries? representatives in the Steering Committee.</i></p>	<p><i>Knowledge on (trans boundary) aquifer management is patchy and transboundary implications have not been assessed nor agreed upon.</i></p>	<p><i>Finalization of the assessment of the aquifers? current state and projected scenarios, as well as of the evaluation of dependent ecosystems.</i></p>	<p><i>Analysis submitted for endorsement to the Steering Committee.</i></p>	<p><i>Minutes of the relevant SC meeting approving analysis</i></p>	<p><i>Effective and inclusive involvement of target stakeholders, local communities and the inhabitants of target aquifer areas throughout project implementation</i></p>	<p><i>PMU</i></p>
<p>Output 2.1.1 Knowledge products, information, and policy products that map groundwater-related risks and opportunities to water security and resilience</p>	<p><i>Assessment, including considerations of gender equality aspects and the use of disaggregated data, endorsed by the countries? representatives in the Steering Committee.</i></p> <p><i>F/M participation of officials from relevant ministries and institutions in the Assessment Team</i></p>	<p><i>Lack of consideration of transboundary groundwater management and aquifer recharge strategies.</i></p> <p><i>Lack of consideration of gender and social inclusion impacts due to groundwater related risks and opportunities</i></p>	<p><i>Assessment report cleared by the SC. Availability of a state of the art models of the aquifer systems.</i></p>	<p><i>Assessment reports cleared by the PMU, GW data inventory.</i></p>	<p><i>Minutes of the relevant SC meeting approving the Assessment report</i></p>	<p><i>Effective support from national scientists, local communities, other stakeholders and administrative bodies</i></p>	<p><i>National executing partners</i></p>

Results chain	Indicators	Baseline	Mid-term target	Final target	Means of verification	Assumptions	Responsible party
<u>Outcome 2.2:</u> RECs, RBOs, MSs capacitated in groundwater assessment tools and approaches	<i>Skills and knowledge on transboundary issues of 200 gender-balanced national staff increased by 50% over baseline levels.</i> <i>Number of staff by gender, locality and age in capacity development activities and stakeholder engagement events.</i> <i>Guidelines on gender and ethnicity integration.</i>	<i>Land and water administrators relevant for groundwater extraction and recharge lack experience in transboundary aspects.</i> <i>Low levels of participation by women and marginalized groups</i>	<i>5 courses held</i> <i>At least 100 trainees</i>	<i>10 courses held</i> <i>At least 100 trainees</i>	<i>Report of training activities, and SC minutes.</i> <i>Written guidelines on gender and ethnicity integration into groundwater assessment</i>	<i>Project management able to raise interest of targeted groups</i>	PMU

[illegible]

Results chain	Indicators	Baseline	Mid-term target	Final target	Means of verification	Assumptions	Responsible party
<p><u>Outcome 3.1:</u></p> <p>Evidence-driven transboundary groundwater management in the Shire aquifer system</p>	<p><i>Demonstration project designs, implementation reports, and upscaling-focused assessments for at least three demonstration projects for improved groundwater management (extraction and recharge) in each country.</i></p> <p><i>Demonstration projects include disaggregated data by gender and ethnic minority.</i></p>	<p><i>Transboundary aquifer management and aquifer recharge strategies and practices that the project will test on the ground are new to the region.</i></p>	<p><i>Demonstration projects under implementation.</i></p>	<p><i>At least 1 demonstration project implemented for each target aquifer.</i></p>	<p><i>Final reports of demonstration projects.</i></p>	<p><i>Countries reach consensus on the typology and location of the demonstration projects during the first year of the project implementation.</i></p>	<p><i>PMU, IWMI, ILASA</i></p>
<p>Output 3.1.1:</p> <p>Gender, Indigenous Peoples presence and water assessment for the transboundary Shire aquifer system.</p>	<p><i>Increased in-depth understanding of gender related issues in terms of water and groundwater for the Shire basin aquifer. ,</i></p>	<p><i>High level understanding of some gender related issues in terms of water and groundwater for the Shire basin aquifer.</i></p>	<p><i>Assessment report completed and approved by the SC.</i></p>	<p><i>Assessment report completed and approved by the SC.</i></p>	<p><i>Minutes of the relevant SC meeting.</i></p>	<p><i>Countries participate</i></p>	<p><i>PMU, IWMI</i></p>

Results chain	Indicators	Baseline	Mid-term target	Final target	Means of verification	Assumptions	Responsible party
Output 3.1.2: Design of harmonized groundwater monitoring network, rehabilitation of non-functional wells and targeted new borehole drilling	<i>Agreement on Design of harmonized groundwater monitoring network.</i> <i>Participation of relevant stakeholders identified by gender, locality and ethnicity in the design and implementation of the monitoring network.</i>	<i>No harmonized groundwater monitoring network</i>	<i>Design process commenced and monitoring network drafted</i>	<i>The design of the groundwater monitoring network approved by the SC.</i>	<i>Minutes of the relevant SC meeting.</i>	<i>Countries participate</i>	<i>PMU, IWMI</i>
Output 3.1.3: Data logger installation in selected boreholes and analysis	<i>Number of boreholes drilled and established for monitoring system</i>	<i>Very few boreholes available for monitoring</i>	<i>2 new boreholes for monitoring drilled and established</i>	<i>4 new boreholes for monitoring drilled and established</i>	<i>Monitoring data from new boreholes.</i>	<i>Fieldwork feasible and budget adequate.</i>	<i>PMU, IWMI</i>

Results chain	Indicators	Baseline	Mid-term target	Final target	Means of verification	Assumptions	Responsible party
of measured data	<p><i>Agreement on the selection boreholes for installation of data loggers including procedures for gender balance participation.</i></p> <p><i>Participation of members of local communities and relevant stakeholders identified by gender, locality and ethnicity in the selection of pilot boreholes.</i></p>	<i>No data loggers installed</i>	<i>Installation of data loggers has commenced.</i>	<i>The program and the design of the demonstration projects approved by the SC.</i>	<i>Minutes of the relevant SC meeting.</i>	<i>Countries participate</i>	<i>PMU, IWMI</i>
Output 3.1.4: Water quality monitoring and laboratory analysis	<i>Agreement on the selection of monitoring variables and provision of water quality analysis.</i>	<i>No consistent water quality analysis available for Shire aquifer.</i>	<i>Monitoring commenced.</i>	<i>Water quality analysis approved by the SC.</i>	<i>Minutes of the relevant SC meeting.</i>	<i>Countries participate</i>	<i>PMU, IWMI</i>

Results chain	Indicators	Baseline	Mid-term target	Final target	Means of verification	Assumptions	Responsible party
Output 3.1.5 Shared data platform to support improved aquifer planning	<i>Agreement on the design of the shared data platform reached.</i>	<i>No data sharing platform available for the Shire aquifer.</i>	<i>Data sharing platform conceptualised.</i>	<i>Data sharing platform established and functional, and approved by SC.</i>	<i>Minutes of the relevant SC meeting.</i>	<i>Countries participate</i>	<i>PMU, IWMI</i>
Outcome 3.2: Groundwater integrated into catchment planning in Uganda	<i>Groundwater Diagnostic Assessment (GDA) and a Strategic Action Plan (SAP) for Upper Nile Management Zone on groundwater management endorsed by the Ministry of Water and Environment.</i>	<i>Groundwater not integrated in catchment planning.</i>	<i>GDA drafted</i>	<i>GDA drafted and recommendations for policy planning presented to relevant stakeholders, and subsequently endorsed by SC.</i>	<i>Minutes of the relevant SC meeting.</i>	<i>All relevant stakeholders participate</i>	<i>PMU, IIASA</i>

Results chain	Indicators	Baseline	Mid-term target	Final target	Means of verification	Assumptions	Responsible party
Output 3.2.1 Tools and evidence base for managing and planning groundwater in the Upper Nile Water Management Zone (UNWMZ) of Uganda	<i>Provision of groundwater management supporting tools and analysis.</i> <i>Increased in-depth understanding of gender related issues in terms of water and groundwater for the Upper Nile Water Management Zone (UNWMZ) of Uganda</i>	<i>No tools available supporting groundwater management.</i> <i>High level understanding of some gender related issues in terms of water and groundwater for the Upper Nile Water Management Zone (UNWMZ) of Uganda</i>	<i>Tools conceptualized and analysis commenced.</i> <i>1 gender assessment report finalized and presented to SC</i>	<i>The conceptualization of tools and design of the analysis approved by the SC.</i> <i>1 gender assessment report finalized and presented to SC</i>	<i>Minutes of the relevant SC meeting.</i>	<i>All relevant stakeholders participate</i>	<i>PMU, IIASA</i>
Outcome 3.3: Supporting integrated aquifer management & Reducing groundwater risks in the Shared Mono Basin	<i>Number of planning decisions integrating newly provided groundwater data.</i>	<i>Groundwater not integrated in transboundary water management planning.</i>	<i>Transboundary monitoring and data sharing drafted and commenced.</i>	<i>Transboundary monitoring and data sharing informs transboundary and national water management.</i>	<i>Minutes of the relevant SC meeting.</i>	<i>All relevant stakeholders participate</i>	<i>PMU</i>

Results chain	Indicators	Baseline	Mid-term target	Final target	Means of verification	Assumptions	Responsible party
Output 3.3.1: Gender, Indigenous Peoples presence and Water Assessment for the shared Mono basin.	<i>Increased in-depth understanding of gender related issues in terms of water and groundwater for the shared Mono basin</i>	<i>High level understanding of some gender related issues in terms of water and groundwater for the shared Mono basin</i>	<i>1 gender assessment report finalized and presented to SC.</i>	<i>1 gender assessment report finalized and presented to SC.</i>	<i>Relevant SC minutes.</i>	<i>Both countries continue to engage.</i>	<i>PMU</i>
Output 3.3.2: Design of harmonized groundwater monitoring network and data loggers installed	<i>Number of monitoring sites established.</i> <i>Number of data loggers installed and number of analysis provided.</i>	<i>No transboundary groundwater monitoring.</i> <i>No data loggers installed</i>	<i>Data design of harmonized groundwater monitoring network presented to SC.</i> <i>Five data loggers installed</i>	<i>Harmonized groundwater monitoring network established and maintained.</i> <i>Ten data loggers installed</i> <i>Analysis completed and presented to SC.</i>	<i>Database shared and SC minutes.</i>	<i>Both countries continue to engage.</i>	<i>PMU</i>
Output 3.3.3: Water quality monitoring and laboratory analysis	<i>Number of years of monitoring.</i> <i>Number of analyses.</i>	<i>No water quality monitoring.</i>	<i>Two years of monitoring completed and data shared.</i>	<i>Four years of monitoring completed, data shared, and analysis presented to SC.</i>	<i>Database shared and SC minutes.</i>	<i>Both countries continue to engage.</i>	<i>PMU</i>

Results chain	Indicators	Baseline	Mid-term target	Final target	Means of verification	Assumptions	Responsible party
Output 3.3.4 Shared data platform to support improved aquifer planning	<i>Number of data sharing platforms introduced and maintained.</i>	<i>No data sharing platform.</i>	<i>Data sharing platform drafted and approved by both countries.</i>	<i>One data sharing platform established and maintained.</i>	<i>Database shared and SC minutes.</i>	<i>Both countries continue to engage.</i>	<i>PMU</i>
Output 3.3.5 Strategic well rehabilitation to reduce flood risk to drinking water supplies	<i>Number of designs of flood protection mechanisms</i>	<i>No flood protection for drinking water</i>	<i>Draft design presented to SC</i>	<i>Designs for flood protection mechanisms for drinking water approved by SC</i>	<i>Minutes of SC meeting</i>	<i>Both countries continue to engage.</i>	<i>PMU</i>
<u>Outcome 3.4:</u> Decision-making on prioritization of groundwater investments enhanced	<i>Number of plans considering groundwater use and management.</i>	<i>Lack of consideration of groundwater in planning.</i>	<i>5 planning processes incorporating groundwater extraction and aquifer recharge.</i>	<i>10 planning processes incorporating groundwater extraction and aquifer recharge.</i>	<i>Planning documents.</i>	<i>Project development strengthens political commitment to transboundary cooperation</i>	<i>PMU</i>

Results chain	Indicators	Baseline	Mid-term target	Final target	Means of verification	Assumptions	Responsible party
Output 3.4.1 Knowledge exchange, study tours & communities of practice to support cross-pilot learning	<i>Number of study tours conducted and communities of knowledge established.</i> <i>At least 40% participation of women and at least 40% participation of youth</i>	N/A	3 study tours conducted and learning effects evaluated; 1 knowledge exchange platform established.	6 study tours conducted and learning effects evaluated; 1 knowledge exchange platform established.	Study tour evaluation reports presented to SC.	Stakeholder from all five pilot areas participate in knowledge exchange.	PMU
Output 3.4.2 Synthesis & dissemination of lessons	<i>Number of assessment reports published and dissemination workshops conducted.</i>	N/A	N/A	One cross-pilot assessment report presented to relevant stakeholders and five national workshops conducted.	Assessment report and knowledge exchange workshop s.	Stakeholder from all five pilot areas participate in knowledge exchange.	PMU

Component 4 Long-term vision and capacity.

Results chain	Indicators	Baseline	Mid-term target	Final target	Means of verification	Assumptions	Responsible party
<u>Outcome 4.1:</u> Youth across Africa is capacitated on groundwater to enhance consideration of social and cross-sectoral dimensions of groundwater	<i>Number of Youth capacitated.</i> <i>50% of representation to be female</i>	<i>Lack of capacity of Youth to improve social and cross-sector dimensions of groundwater,</i>	<i>50 Youth involved in G4DR activities and 5,000 Youth reached by G4DR outputs.</i>	<i>100 Youth involved in G4DR activities and 10,000 Youth reached by G4DR outputs.</i>	<i>Youth Forum meetings and website content.</i>	<i>Project management able to raise interest of targeted groups</i>	PMU, IWMI
<u>Output 4.1.1</u> Youth Forum for G4DR ? creating opportunities for youth of all genders and social differences i) for learning and interaction with professionals and decision makers active in groundwater; and ii) putting forward their voice in decision making processes.	<i>TOR for Youth Forum endorsed by participating agencies and at least 3 meetings held.</i>	<i>Lack of Youth Forum for groundwater related issues.</i>	<i>TOR for Youth Forum endorsed by participating agencies and at inception meeting held.</i>	<i>TOR for Youth Forum endorsed by participating agencies and at least 3 meetings held.</i>	<i>Youth Forum minutes.</i>		

Results chain	Indicators	Baseline	Mid-term target	Final target	Means of verification	Assumptions	Responsible party
Output 4.1.2 Website or social media platform by the Youth Forum, attracting youth to the debate and building knowledge sharing around the importance of youth in taking an active role in G4DR in Africa, and continue driving the agenda forward.	<i>Number of websites of social media platforms, number of posts/articles published, and number of years maintained.</i> <i>Number of youth outreach ambassadors for the G4DR project as a part of the Forum.</i>	<i>Lack for online platform empowering the youth in groundwater use and management.</i>	<i>Website or social media platform established and maintained for at least 1 year.</i>	<i>Website or social media platform established and maintained for at least 3 years, and continued support secured for post-project maintenance.</i>	<i>Websites.</i>		
Component 5 Knowledge management and M&E: Supporting capture, exchange and dissemination of key project advancements, as well as evaluation of project progress relative to targets							
<u>Outcome 5.1:</u> Knowledge management & dissemination to support visibility and adoption	<i>Number of communication strategies endorsed and dissemination events held.</i>	<i>N/A</i>	<i>1 communication strategy endorsed;</i> <i>2 events held</i>	<i>1 communication strategy endorsed;</i> <i>4 events held</i>	<i>Endorsement documents;</i> <i>Meeting minutes</i>	<i>Project management able to raise interest of targeted groups</i>	<i>PMU, IWMI</i>

Results chain	Indicators	Baseline		Mid-term target		Final target	Means of verification	Assumptions	Responsible party
Output 5.1.1 Programme findings and lessons learned identified and contribute to IW:LEARN .	<i>Number of dissemination events and experience notes / documents / videos including on gender activities.</i> <i>Coordination mechanisms with relevant national and international stakeholders implementing NRM, water and agricultural fisheries activities.</i>		<i>2 events 10 documents 1 video</i>		<i>4 events 30 documents 2 videos</i>		<i>Project website including a TBA Gender and Ethnicity on-line resource library</i>		

Results chain	Indicators	Baseline		Mid-term target	Final target	Means of verification	Assumptions	Responsible party
Output 5.1.2 Information sharing mechanism & communication strategy developed enabling broad access to best practices and lessons learned in the countries supporting AMCOW.	<i>Number of information sharing mechanisms and number of communication strategies endorsed.</i>		<i>Information sharing mechanism & communication strategy developed</i>	<i>Information sharing mechanism & communication strategy developed</i>	<i>Endorsement documents for information sharing mechanism & communication strategy</i>			
<u>Outcome 5.2:</u> Adaptive results-based management and sharing of information and lessons learned.	<i>Number of monitoring systems operational and number of information</i>	N/A	One monitoring system established and	Three or more information updates provided to identified stakeholders.	Documented monitoring updates.			

Results chain	Indicators	Baseline	Mid-term target	Final target	Means of verification	Assumptions	Responsible party
Output 5.2.1 Gender responsive monitoring system operating and providing systematic and regular information updates on progress towards reaching G4DR targets	<i>updates provided.</i>		operational.				

ANNEX B: RESPONSES TO PROJECT REVIEWS (from GEF Secretariat and GEF Agencies, and Responses to Comments from Council at work program inclusion and the Convention Secretariat and STAP at PIF).

GEF SEC Review comment	Agency Response FAO

Throughout the PIF/project description please focus though on the IW and GEFTF mandate on water security and resilience and addressing intersectoral trade-offs of water uses (along the water-food-energy-environment Nexus) which includes the need to involve cross-sector players instead of what looks for now an overlap with the LDCF/SCCF and focus on climate and revising adaptation plans. These intersectoral trade-offs and especially with regard to agricultural uses and plans exist already now and groundwater can be both a solution and a victim of overuse by agriculture and urban development. Future trends - including climate change, population growth, urbanization and related demands on resources - will add to these pressures. The PIF is also silent about the role of groundwater and water security and land degradation as risk multipliers for local conflicts and displacement which will be aggravated by climate change and providing another reason for sustainable management of this resource.

During project preparation it will be important to make these cross-sectoral linkages and need for consistent policies and aligning incentives concrete by involving e.g. key agriculture and urban entities in the preparation process. Also, at endorsement stage, please be specific and detailed how the project will do so during implementation.

Additional text has been added to address this

comment. This includes new text to emphasize the contribution to the IW objectives, especially on water security, resilience and addressing intersectoral trade-offs of water uses, the role of groundwater and water security, and land degradation.

PPG phase: During the PPG phase water security has been clearer pronounced in the project description sections.

We also included specific groundwater-related Nexus trade-offs into the Component 2 of Pan-African assessment and the baseline sections for the Shire aquifer, Uganda, and the Mono River basin.

<p>The project structure is overall clear but please address the following:</p> <ol style="list-style-type: none"> 1. Please consider to modify the PDO and replace 'adaptation planning' with 'planning for resilience'. This would better align with the project title and activities, the AMCOW mandate and strategies linking water security to resilience and the GEF TF programming directions. 2. Please include a component or sub-component on M&E (incl. funds for it). 3. Please include a sub-component on knowledge management and include within this 1% of GEF grant for participation in IW-learn (incl. participation in the IWCs, regional learning events, drafting of experience notes and knowledge exchange, project website) 4. Given the importance to communicate the role of groundwater for development (and avoiding over-abstraction and pollution) a communications strategy and products seems important; can this be included in component 4 or otherwise a component 5 that may e.g. communication as well as KM, and M&E needs? 5. There are several slide 'odd' wording/formulation issues in table B that could benefit from editing and clarification: <ul style="list-style-type: none"> i.) Component 1: please clarify "groundwater-based policy and planning". I assume that this is AMCOW support to strengthen the consideration of groundwater in cross-sectoral policies, strategies and planning on national and regional levels. As written the meaning of 'groundwater-based policy and planning' is unclear. ii.) Outcome 1.2: What is "demand and reporting on tools..."? " would it be "increased capacity to and use of tools to assess groundwater quality and quantity and support greater resilience to shocks " (incl. extreme climate events, pandemic, etc.)? In addition, 'reporting on <p>quality and quantity and support greater resilience to shocks (incl. extreme climate events, pandemic, etc.)? In addition, reporting on</p> <p>tools' is unclear: what will be reported and why and to who? Seems an editorial item.</p>	<ol style="list-style-type: none"> 1. 'Adaptation planning' was replaced with 'planning for resilience'. 2. 3. and 4. A new component 5 has been added to target M&E. Funds were allocated to the purpose. This includes knowledge management, the 1% of GEF grant for participation in IW-learn and the development of a communications strategy. 5. Table B has been reviewed and reformulated to address the comments of GEF SEC.
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iii.) Please reread outcome 1.3 and reword to clarify what is meant here. We would be happy to discuss if this aids in clarification.

iv.) Output 1.2: the annual knowledge sharing event is appreciated. Please assure that it does not duplicate but enhance, e.g. the SADC yearly event on groundwater and the 'Africa Water week'. It is less clear what the origin of a "reporting framework among basins and other stakeholders" is and what "deliverable to AMCOW and AU" means and who the user of this will be. Is there such a requirement? Please consider and balance effort with usefulness (see also comments under part II, question 3).

v.) Please revise output 3.3 to better align with the component text. The component defines two pilots that include modeling approaches while the other pilots (tbd) will be based on other criteria and not necessarily "evidence-based groundwater inclusive planning ..." which seems to be 'code' for a more modeling approach versus on the ground pilots.

vi.) Please clarify the wording for outcome 4.1 to make clear what the youth players will be expected to engage in and what they will be their capacity needs to what exactly? i.e. what is the objective. Also, how is youth supporting financing, and what are they networking on - again on the youth side one would hope that this engagement aims at a view that addresses the role of water and groundwater specifically in terms of social and cross-sectoral dimensions. Please and wording to formulate an outcome statement for the youth network. The component name of component 4 is better suited here than the outcome statement.

(4/12/2022) The above comments have been addressed. In the formulation of the project document please take care to use practical language throughout that expresses what will be done and avoid jargon.

<p>1. Please delete the text under the table as none of the co-finance is classified as investment mobilized.</p> <p>2. During project preparation, please explore further co-finance e.g. from other partners supporting AMCOW and ANBO especially those engaged in groundwater support to AMCOW directly or indirectly by supporting tools used by countries and promoted by AMCOW such as e.g. BGR, Swiss support, WB managed CIWA trust fund, UNESCO, IGRAC, and others. Second, please have a closer look with AMCOW at their in-kind support which via staff time and office support is likely to exceed 100 K over the four years.</p> <p>(4/12/2022)</p> <p>Comment addressed under 1 and the agency response on 2. noted. Agree that is best being done in the wider consultation process during PPG.</p>	<p>1. Done</p> <p>2. AMCOW has indeed increased their level of cofinance and discussions have indeed been held with other such as CIWA. In addition, SADC-GMI has provided a letter of cofinance.</p>
<p>The requested PPG is within the allowable cap.</p> <p>1. Please change the Country entry from ?Africa? to ?Regional? in each table and all other sections as appropriate, incl. PPG request and programming of funds tables.</p> <p>(4/12/2022)</p> <p>Noted. Please submit LOEs for additional countries that may/will be part of the additional pilots at endorsement stage and the add these in the list of countries in the portal.</p>	<p>1. Done. The project was labelled as "Regional? with the three countries where the pilots will take place (component 3), plus Africa for the PAN-African dimension of components 1, 2, 4 and 5.</p>

<p>(4/15/2022) Please discuss with us to explain the way indicator 7 (incl. sub-indicators 7) were used and during project preparation refine e.g. the estimate of direct beneficiaries via the pilot and capacity building interventions. The pilots alone have a budget of USD 3 million (not counting training efforts, youth engagement etc.) and 1000 beneficiaries therefore appears low for the overall project.</p> <p>(4/12/2022) Comments addressed incl. the explanation on stakeholders.</p>	<p>Re to CI7: CI7 was set to 1 - global because the project has a Pan-African dimension, i.e. will benefit all the aquifers in the continent. CI 7.1, 7.2, 7.3 and 7.4 were all set to 1 because, globally, all these elements need to be developed by the project.</p> <p>Re to CI11: The figure was increased to 1,200.</p> <p>The indicated for the PIF stage, is assuming that component 1 one will target 150 direct beneficiaries, component 2 will target 200, component 3 will target 400 and component 4 will target 450.</p> <p>Additional direct beneficiaries will be identified during the project development phase in parallel with the definition of additional national pilots. Also, if the project manages to improve the policy/governance, potentially the direct beneficiaries can increase hugely.</p>
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(4/15/2022) There is valuable information provided but still some key points that need refinement and addition.

1. Please across the document balance the concept of creating resilience to a range of shocks with assessment of existing water needs and use trends and the expected increase in demands on surface and ground- water. Groundwater presents opportunities to sustain water supplies for people, nature, and economic sectors given these trends AS WELL AS (but not only) in the face pf increasing climate variability and change (and e.g. extended droughts). There is not clear enough attention given to highlight the major current and future uses and users of groundwater in the context of Africa's major water intensive sectors (e.g. including agriculture, increasing urban uses, and mining), attention to barriers to sustainable management, incl. e.g. incentives - or lack thereof - to enhance more efficient use of water and groundwater nor discussion on root causes (incl. governance related). The White Paper presented by AMCOW at the World Water Forum this March could be helpful here to draw from.

2. Water quality threats - incl. natural and anthropogenic - would need clearer highlighting as relevant especially to the region. A good overview is provided e g in the recent publication from the World Bank on groundwater quality and accompanying sampling guidance released at the time of the World Water Forum in Dakar this year: "Seeing the Invisible: A strategic report in groundwater quality", Peter Ravenscroft and Lucy Lytton, 2022.

(4/12/2022) Additional text and references noted and adequate at this stage. Please expand on this and maintain these aspects as important to the project during project preparation.

1. New text has been added or paragraphs reformulated to address the comments of GEF SEC. The revisions aimed for a much more balanced description of the baseline, as suggested by this review comment. Now, we also refer explicitly to AMCOW's White Paper.

2. We clarified water quality threats and made explicit references to the WB report.

Baseline

(4/15/2022)

1. The baseline should be clearer on the ongoing initiatives and strategies on water and development in Africa. Again, the AMCOW white paper is useful for this (as well as in the PIF section on the regional policy context). The mention of ANBO is appreciated which BTW received GEF support via UNDP as implementing agency and addressed both transboundary basins and aquifers.

CIWA and GEF are also supporting the SADC groundwater work including SADC-Groundwater Management Institute (SADC-GMI). SADC-GMI deserves some attention in the baseline hosting a yearly knowledge exchange event on groundwater as well as the SADC water sector doing the same among RBOs. SADC-GMI lessons on how to include groundwater in basin management as well as various pilots in the region will be highly relevant for the project (incl. design and budget of pilots) and knowledge exchange efforts as well as SADC-GMI's successful engagement to bring in finance via providing expertise to RBOs.

Similarly, OSS is an important center of expertise in West Africa and IGAD yet emerging in its role on groundwater management in the Horn of Africa (with current support e.g. by CIWA to IGAD and a number of countries in the Horn of Africa).

Furthermore, the Africa GEF portfolio is important beyond the projects mentioned already, as well as GEF support to countries and RBOs by

BGR, UNESCO and its GRETA program, IGRAC, Swiss etc. all of which also work with AMOW and/or ANBO.

There is also a relatively recent update of a groundwater map for Africa /WHYMAP from 2018 and the Africa groundwater atlas to be mentioned in the baseline.

2. As mentioned earlier, there is a need to link groundwater uses with ongoing use in agriculture (as the major employment in most countries across Africa), expanding urban development and other relevant uses and identify the levers and links that AMCOW needs to bridge to change the trajectory towards greater attention to sustainable management and protection of groundwater.

New text has been added and relevant paragraphs reformulated to address the comments of GEF SEC. We added explicit references to AMCOW's White Paper and the SADC work. The execution phase will build on the lessons learnt from the SADC work and other related projects in the three focus areas and at the pan-African level.

2. The baseline section has been significantly expanded and draws now explicit links between water security and agricultural activities and other livelihoods. Data limitations have been raised in various places in the ProDoc.

3. Thanks for pointing this out.

4. This has been added as the PPG team engaged with various youth groups to design the details of Component 4.

Climate risks will increase threats for extreme events and groundwater resources and recharge will be impacted but also provide great opportunities for these major uses and users to lessen the impacts of e.g. extended droughts. The link from climate models to surface and groundwater uses across sectors will be addressed in component 2 - among other - which is extremely useful to support and Africa Strategy on Groundwater and is building on the work on ISWEL to highlight x-sector hotspots and threats to groundwater quality and quantity. Limits on available and reliable data and information are an obvious limitation and it would be important to provide an idea on such limitation now and/or during PPG.

3. Please throughout the PIF be conscious that the project and the GEFTF is accessed here and not the LDCF/SCCF (which would directly link with the UNFCCC and support to NAPs).

4. Youth networks and national youth parliaments on water or other networks active or emerging would be worthwhile mentioning as component 4 will aim to build on existing efforts and momentum (incl. initiatives that may emerge from the Dakar Forum in this direction).

(4/12/2022) The next text is noted and we hope that this will be further paid attention to **during project design**. Collaboration and building synergies across development partners and ongoing efforts will be essential to increase attention to improved governance and valuing groundwater across sectors. **Please also document consultations with youth networks during the project preparation process to reflect their voices and ideas in project design.**

(4/15/2022)

1. For the most part this is done, but the intervention logic (initial Theory of Change) narrative (and supported by a schematic) needs strengthening.

2. Component 1: during project preparation it will be important to take stock of ongoing regional and continent-wide knowledge sharing fora (incl. e.g. Africa Water week; SADC groundwater and RBO region-wide meetings; IGAD Forum; etc.) and devise a strategy with these organizers that strengthen these as well as enable cross-regional exchanges and twinnings, but does not duplicate events which would be costly and hard to sustain. Exchanges of experiences lessons from outside the region on conjunctive management and regulatory and incentive structures for protection of soil and groundwater from contamination may be of interest to explore as well during PPG and project implementation.

3. Component 2: The illustrative data sources are very useful. Obviously, FAO is another source of data on groundwater and e.g. possible areas of high fertilizer and pesticide uses; other partners to mention here are BGR and UNESCO, IGRAC, and the WB report on groundwater quality and its references contained therein mentioned earlier (by Ravenscroft and Lytton, 2022).

4. Component 3 is an important attribute to demonstrate opportunities, innovative approaches and benefits via improved groundwater governance and management. The two pre-identified pilots are well placed to expand ongoing work and demonstrate what is framed as "evidence-based planning" to support impacts on the ground. Other pilots which will be based on criteria to be developed with AMCOW and regional and national member country expertise to e.g. address and locally pilot improved governance and co-management with users (such as farmers associations), innovative technical approaches, and partnerships e.g. with specific private sector partners to avoid groundwater contamination, etc.. IWMI's expertise and experience in Africa and around the globe will be excellent to bring into bare here. Initial types of criteria for selection of other pilots would be important to indicate here as the majority of GEF funds is directed towards component 3. Furthermore, will there be a pilot or pilots that specifically targets women's groups/ entrepreneurs?

1. New text has been added or reformulated for each of the five components to address the comments of GEF SEC. The ToC (see Figure 9) was substantially expanded to include barriers, assumptions, and causal pathways, and an extensive narrative is provided on pages 46-63.

2. The EA had extensive discussions with AMCOW regarding pan-African knowledge sharing fora that relate to (ground)water management, incl. Africa Water Week, SADC and IGAD's initiatives. The project will extensively engage with these platforms and initiatives to realise synergies and learning while avoiding any duplications. The project will also include processes to exchange experiences with initiatives on other continents, in particular through IW: LEARN.

3. Data sources have been added, including FAO, WB, IGRAC and others, see page 49.

4. Activities under Component 3 have been specified for the three targeted sites in discussions with relevant stakeholders. For all sites a gender and water assessment will be conducted, which will guide the involvement of women's groups to further advance gender equality. Also, private sector actors will be brought into the execution of Component 3.

5. Many thanks for your advice. We elaborated on the inter-generational rationale for focusing on youth and establishing a youth forum.

<p>5. Component 4: Please develop the logical reasons of this intervention better. Groundwater overuse and pollution will have intergenerational impacts and legacies that impact future generations as e.g. salinization and pollution or depletion of fossil aquifer reserves are there to stay in one form or the other. This is one reason to activate the voice of younger people to engage in this agenda. Yet, the logic of the specific focus on youth versus little other communications and awareness raising efforts is not entirely well explained.</p> <p>(4/12/2022) Comments addressed at PIF stage. Agree that the intervention logic as a whole of the project - across components and stakeholders - will need to be updated to enhance the project logic in a more cohesive manner. At PIF stage this is clear enough but details to be developed with partners at various levels and across sectors during PPG.</p>	
<p>Incremental reasoning</p> <p>(4/15/2022) Please strengthen this section and the benefits of the GEF increment compared to purely national efforts as well as the GEBs associated with strengthening sustainable groundwater use from a regional, pan-African approach and greater economies of scale of developing policy guidance, deploying expertise and knowledge exchanges on a regional scale.</p>	<p>New text was included to strengthen this section and address GEF SEC comments</p>

<p>GEBs</p> <p>1. This section seems to try to add more ideas and activities to the project and could use some more clarity. It raises issues of building central/consistent groundwater database (?), and identifying adaptation solutions - neither of which seem to be part of the project scope.</p> <p>2. Please also revise the language of "G4DR will engage with ... ". The project while executed by IWMI (components 1, 3, and 4) and IIASA (Component 2) and we understand is intended to serve and drive forward the AMCOW Africa agenda, support the AMCOW groundwater desk (together with other partners) and with the administrative capacity of AMCOW being enhanced to house the PMU by the mid-term of the project. It seems odd that it reads as if the project is a separate entity and dissociated from AMCOW.</p> <p>(4/12/2022) Comment addressed with revision of the section in the resubmission.</p>	<p>1. The global environmental benefits section has been restructured completely.</p> <p>2. The Coordination section was rearranged and restructured completely.</p>
<p>Innovation & sustainability</p> <p>1. The text in the PIF could use some more clarity. It is unsure what and how the project provides a 'commercially viable model among the involved actors', or what actions will truly be targeting 'various groundwater related value chains'. One of the pilots will address 'borehole drillers and water procurement distribution', but it is less clear for the wider project and the text should be clear when it refers to the specific pilot. The text goes on to mention improved WASH practices, blended finance for carbon sequestration and carbon offsets etc. etc. and leaves the reader frankly a bit lost on how to relate this to the project.</p> <p>2. Further, it reads somewhat ambitious that the project is not only targeting policy making across Africa but also seems to aims to be "crucial" to development of GEF strategies (see PIF). We certainly hope that the findings will have great relevance across sectors, but may want to see and maintain some real focus on the client/region.</p> <p>(4/12/2022) The substantial revision is noted.</p>	<p>New text has been added or paragraphs reformulated to address the comments of GEF SEC. The Innovation, sustainability and potential for scaling up was restructured completely</p>

<p>Stakeholders</p> <p>The PIF includes a description of a range of stakeholders and their current roles.</p> <p>1. Please describe who has been involved in the formulation of the PIF (i.e. to date), how and when.</p> <p>2. Please spell out acronyms when first uses, e.g. what are MSs? Ministries?</p> <p>3. Please rename the last column in the table on stakeholders to be involved during PPG: instead of "Role in project engagement" which is</p> <p>3. Please rename the last column in the table on stakeholders to be involved during PPG: instead of Role in project engagement which is</p> <p>unclear if this is in the project development or in project implementation. It may be most pertinent to mostly focus on the project preparation phase here in the PIF: Which groups will participate in the design process and how will they be involved?; which groups will be</p> <p>consulted - when and by what means?; etc. This could be an important step to developing a rough work plan for the process of project preparation.</p> <p>4. For now the text in the last column tends to be somewhat generic and vague in outlining roles as "knowledge generators, uptake partners, etc. ". If you prefer you could start populate a fourth columns that starts to indicate the envisioned/potential roles of players in project implementation. AMCOW, and the three regional centers on groundwater with respective RECs clearly will be important during project preparation.</p> <p>(4/12/2022) The revisions have been noted and we have evidence through conversations that the stakeholders listed as having been consulted with and contributed to the PIF development have done so. Please, for future reference and during the project preparation process, please document when and where you consulted with who and annex to the prodoc. At that stage, the role of the listed stakeholders plus additional ones to be identified during PPG need to specific and clear for each. Please do not forget to involve the water and youth networks on regional and some of the national ones in project development. Same for key sector actors in agriculture and urban development as without these cross-sector actors? policies and guidelines on groundwater management (quantity and pollution prevention efforts) will have little chance to have</p>	<p>1. Indication on who was involved in the formulation of the PIF has been included.</p> <p>2. The acronyms have been spelled out when first uses</p> <p>3. The last column in the table on stakeholders to be involved during PPG was renamed to focus on the project preparation phase</p> <p>4. The table on stakeholders was slightly reorganized to provide more clarity.</p> <p>Recommendations for future submissions are well noted.</p>
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<p>any practical application and impact. Please address in much more detail during project preparation.</p>	
<p>Gender</p> <p>(4/15/2022)</p> <ul style="list-style-type: none"> - There could be a more practical set of considerations considered such as the rights of women to land and water, and often related to this their opportunities to access credits and finance for entrepreneurial activities including those that require groundwater for irrigation, food processing or other and related investments. This potentially could also be a factor in the design of a pilot/s. - While the write-up is written in progressive terms ('challenging social norms, cultural values and social life in terms of decision-making power that reinforces gender and intergenerational equity' ... etc.), it would be useful to inject tangible and measurable actions that are reflected in project design. Please revise the text. - In addition, and outline relevant steps for project design, e.g. provide some additional information on project analysis / assessment to be carried out during project preparation and plans to address gender dimensions in the pilots. <p>(4/12/2022) Thank you for addressing the comments in the resubmission. During project preparation it is therefore extremely important to see gender aspects addressed throughout the document and made explicit within the component design, including but not limited to the pilot interventions.</p>	<p>The gender section has been reviewed and expanded to address GEF SEC comments.</p> <p>During the PPG phase a preliminary gender analysis was carried out and a clear focus on gender was introduced into all project components, which includes the addition of new outputs in the Results Framework with their respective tangible and measurable actions and indicators.</p>

Private sector

(4/15/2022) Please be more specific in what types of private sector partners will be most relevant in Africa to advance sustainable use of groundwater and approaches in the project design (such as, e.g. to promote voluntary actions; appeal to a consumer base (which by national or international) by commitments to responsible use of inputs to production; or private sector dialogues to influence policies and regulations; ... other). Are there any known champions that could lead a peer dialogue in key sectors?; is there an option to work via existing industry roundtables? and/or influence sustainable supply chains which were mentioned in the PIF? Will there likely be a pilot specifically designed to target private sector partners either via soft (commitments, labeling, regulations, ..) or physical investments.

(4/12/2022) The revised text is noted. During project preparation, please identify specific actors from the private sector or those regulating private sector entities and work with them to identify what voluntary or regulatory means and incentives can and need to be advanced to avoid groundwater over-abstraction and pollution.

The Private Sector Engagement section has been reviewed completely and expanded to address GEF SEC comments.

Specific private sector actors have been identified as recommended in this comment, see Section 4 on pages 79-81.

<p>Risks</p> <p>(4/15/2022)</p> <p>1. The PIF explicitly addresses climate risk and climate impact on regional development.</p> <p>2. Please expand consideration of risks with regard to e.g. ownership and interest of countries and/or private sector partners in the development of policy guidelines.</p> <p>3. What if e.g. the second phase of APAGrop is not getting started? Would the AMCOW groundwater desk continue to advance the project?</p> <p>3. Capacity risks: The additional pilots may be more likely local or national than regional. Lessons can be learned from the SADC project to work in low capacity environments and building on local knowledge and working with local stakeholders on relevant pilots that could be replicated or scaled -up.</p> <p>3. The table entries referencing component 3 need update as the former component 3 was dropped. (4/12/2022) Comments addressed.</p>	<p>The Risk section has been reviewed completely and expanded to address GEF SEC comments. This will have been further strengthened during PPG phase.</p>
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Coordination

(4/15/2022) Yes, this is outlined in the PIF.

1. IWMI has an immense experience in Africa and across the globe to bring to the effort and linking water-food-land-ecosystems. This will be strengthened and broadened within the new configuration of an integrated CGIAR system

2. The combination of IIASA and IWMI to support AMCOW and the wider AU development agenda holds great promise and is a pilot in itself to link world-class modeling expertise in IIASA with applied research within the CGIAR system to directly serve client countries in addressing challenges and opportunities.

While this has been practice in the CGIAR institutions, component 2 spearheaded by IIASA adds best available data and intersectoral modeling to underpin regional AU policy and strategy formulation. IIASA also scales these efforts down to provide proof-of-concept in one of the pilots to link a highly sophisticated institution and modeling capacity with the national and local clients in Uganda. Successful implementation of that pilot could open a wider vision of collaboration and applied science within the IIASA network of members for the benefit of countries.

3. During project preparation/PPG please explore concrete/measurable synergies and collaboration platform across partners - including GRIPP partners - in support of AMCOW and member states on groundwater. AMCOW had previously voiced a strong interest for a collaboration platform of partners aligning behind Africa's strategies and support needs for water, incl. groundwater, spearheaded by AMCOW.

4. The transfer of the PMU to AMCOW and successive building of AMCOW's project management capacity is well noted. This will be essential to maintain ownership within AMCOW and to support sustainability.

5. During PPG develop a clear plan of the AMCOW groundwater desk and APAGRoP 2 to collaborate and work through the three regional REC supported centers on groundwater in Africa (via SADC, IGAD, and ECOWAS).

(4/12/2022) Noted. Please reassure during project preparation that the goal is to transfer the PMU to

(5/2/2022)

The coordination section has been completely restructured. This will be further strengthened during PG phase.

Re 1&2: Thanks for these comments. We believe that the improvements we made to the project design, in particular to Component 3, will allow us to serve the focus countries even more effectively.

Re 3: We included references to GRIPP and WFaS as well as ISI-MIP and ISWEL, see page 88.

Re 4&5: Agreed, see Section on Institutional Arrangements and the narrative for Component 1.

<p>AMCOW well before the finalization of the project to assure continuity and sustainability. Please formulate clear plan to strengthen AMCOW admin capacities and transparent path and conditions to be met to enable that transfer.</p>	
<p>Knowledge Management</p> <p>(4/15/2022)</p> <p>1. This is inherent in the concept/logic of the PIF but needs concretization in the PIF (incl. table B and components and budget).</p> <p>2. Please also include information about: 1) an overview of existing lessons and best practice that inform the project concept, 2) proposed tools and methods for knowledge exchange, learning and collaboration, and 3) proposed knowledge outputs to be produced and shared with stakeholders.</p>	<p>(5/2/2022)</p> <p>These comments were addressed by introducing a new component 5.</p>
<p>Country endorsements</p> <p>(4/15/2022)</p> <p>1. The project is covering all countries in Africa and will require LOEs only for countries with on the ground activities. At endorsement stage all LOEs for countries with pilots have to be provided. At PIF stage countries with pilots identified in the PIF have to be provided.</p> <p>2. The LOE for Mozambique is still missing assuming Moz is to participate. Else the text would need to clearer that it is not. LoEs from Uganda and Malawi have been provided.</p> <p>3. In the Project Information section, please correct the "Countries entry", delete ?Africa? and next to "Regional" (instead of "Global"), add ?Uganda, Malawi?, as well as Mozambique - if applicable.</p> <p>(4/12/2022) The LOE from Mozambique has been provided. Please note that at ER stage LOEs will have to be provided from other countries in which additional pilots are identified during project preparation.</p>	<p>(5/2/2022)</p> <p>2. The LOE for Mozambique was uploaded in the Portal. 3. Done</p> <p>PPG phase:</p> <p>Two more LOEs, from Benin and Togo, were added following the inclusion of the Mono Basin as a pilot.</p>

<p>(5/10/2022) There are two small formal changes in the portal still needed:</p> <ol style="list-style-type: none"> 1. In Part I Project Information: Countries: Delete "Africa" and just say: Regional (Malawi, Mozambique, Uganda) 2. Table D: Change "Africa" to "Regional" in the country column (as was already done in table E). 	<ol style="list-style-type: none"> 1. Done 2. Done
<p>Secretariat Comment at PIF/Work Program Inclusion</p>	
<p>- Deep Resilience ? this term seems unusual and does not truly seem to add to clarity. During project preparation/PPG you may want to consider if the term gains traction. 'Groundwater for Resilience' seems perfectly fine to be used in the title and throughout.</p> <p>- Please pay attention to comments and reminders which have been included where significantly more clarity is needed at endorsement stage.</p>	<p>Title changed to: ?Groundwater for aDvancing Resilience in Africa (G4DR in Africa)?</p> <p>The ProDoc no longer refers to ?Deep Resilience?, which made editorial changes to elements of the Results Framework necessary.</p>
<p>STAP review</p>	

<p>Minor.</p> <p>The PIF provides detailed information on the role of groundwater for climate security and social and economic development across the African continent, as well as the challenges in its conservation and sustainable use.</p> <p>Lack of finance and investment are identified as major barriers to enhancing groundwater protection and sustainable use. Activities under the project aim to catalyze large scale infrastructure investment through institutional capacity support, build the evidence base through analysis and pilot projects, and work with youth to bring greater awareness to the problems and solutions surrounding groundwater pollution and depletion.</p> <p>A TOC diagram is presented that lists the various outputs, outcomes and assumptions ? all in support of the project objective. However, the main barriers to conservation and sustainable use of groundwater are said to be lack of finance and investment, and these key elements are not included in the overall TOC. Rather, challenges are presented which seem to be tailored to the outputs and outcomes leaving the reader questioning whether critical pieces are missing or obscured.</p> <p>The statement on innovation is not particularly convincing, with the possible exception of the extensive approach to mobilizing youth for engagement in groundwater management.</p>	<p>PPG phase:</p> <p>During the PPG phase a new ToC diagram was developed with explicit barriers. The finance-related barrier has also been made explicit in connection to the third outcome.</p> <p>Also, the statement on innovation has been substantially expanded.</p>
<p>Consider opportunities to integrate remote sensing tools, such as NASA's GRACE satellite sensor, capable of monitoring groundwater changes from space.</p> <p>Given the continental reach, stakeholder identification is appropriately focused on regional institutions. However, if the pilot projects are to be successful it is likely that local communities and other non-government actors will need to be engaged through well-articulated objectives and incentives. Similarly, it will be important to understand how the various regional institutions are seen to interface with national government, civil society, and private sector actors. This merits further elaboration during PPG stage.</p>	<p>PPG phase:</p> <p>During the PPG phase the Section on Innovativeness has been substantially expanded and includes now explicit references to remote sensing technology. The ProDoc now explicitly outlines (see page 71) how project activities will utilize GRACE as well as WaPOR.</p> <p>Section 2 provides now details on the planned engagement process with stakeholders and how the various project components (in particular Component 1 and 3) will interface with regional, national and transboundary institutions.</p>

<p>Baseline scenario</p> <p>Data is a key barrier, so developing a robust baseline will be critical early in implementation, pointing again to the important role of timing for each of the components and a clear articulation of how they related to each other.</p>	<p>PPG phase:</p> <p>During the PPG phase the baseline section was completely re-written with very explicit focus on the three pilot sites.</p>
<p>ToC</p> <p>A TOC diagram is presented that lists the various outputs, outcomes and assumptions ? all in support of the project objective. However, the main barriers to conservation and sustainable use of groundwater are said to be lack of finance and investment, and these key elements are not included in the overall TOC. Rather, challenges are presented which seem to be tailored to the outputs and outcomes leaving the reader questioning whether critical pieces are missing or obscured.</p> <p>The sequence of events is not apparent from the TOC ? that is, a clear articulation of how outputs and outcomes related across components. This merits attention during PPG stage.</p>	<p>PPG phase:</p> <p>During the PPG phase a new ToC diagram was developed, which outlines explicit barriers, including the finance related barrier. The new ToC also clarifies the sequence, which is further supported by the work plan.</p>
<p>ToC Assumptions</p> <p>Assumptions are included in the TOC but could be unpacked with alternative pathways to depict what would need to happen if the assumptions don't hold. For example, what if there is no buy-in and co-finance to implement pilots? What happens to the rest of the project? It could be useful to elaborate a range of scenarios for project implementation, depending upon key variables.</p>	<p>During the PPG phase the narrative for the ToC has been expanded and includes more detail on assumptions, barriers, and pathways.</p>
<p>Project adaptation required?</p> <p>Not clear.</p> <p>Project's resilience to climate change</p> <p>Though no in-depth information is provided on climate change impacts, the project itself is designed to support resilience through conservation and sustainable use of groundwater. This is logical; however, a more explicit link between activities and climate resilience under different climate scenarios would be helpful. While not necessarily applicable at the continental scale, it may need to be refined at project sites and pending the results of the analysis in Component 2.</p>	<p>The PPG phase did not allow for delineating climate change scenarios. This will be a core focus for Component 2 during the implementation phase. However, the background and baseline sections provide climate projections while the Section describing the alternative scenario defines how the various activities improve the resilience of communities and ecosystems to climate change: Through planning and policy support (Component 1), additional evidence (Component 2), and activities on-the-ground in three selected focus areas (Component 3.)</p>

<p>Innovativeness</p> <p>The statement on innovation is not particularly convincing, with the possible exception of the extensive approach to mobilizing youth for engagement in groundwater management.</p> <p>Consider opportunities to integrate remote sensing tools, such as NASA's GRACE satellite sensor, capable of monitoring groundwater changes from space.</p>	<p>PPG phase:</p> <p>During the PPG phase the Section on Innovativeness has been substantially expanded and includes now explicit references to remote sensing technology.</p>
<p>Scaling</p> <p>The assumption is that pilot projects will be innovative and designed with replicability and scaling in mind. However, without information about the pilot projects, this is difficult to assess.</p>	<p>PPG phase:</p> <p>During the PPG phase the context for the three pilots has been substantially expanded under the baseline section. Component 3 has been completely revised and substantially expanded with a third 'pilot' being established with the Mono Basin Authority for the Mono basin. Further, information has been added under the component descriptions, the work plan, and the section on scaling (see Section 7 on pages 70-73).</p>
<p>Sustainability</p> <p>Difficult to assess on the basis of information provided. Incremental change may be sufficient at particular project sites but transformational change is necessary for the groundwater to be perceived and valued differently, and for the innovations to shift governance patterns at scale.</p>	<p>PPG phase:</p> <p>During the PPG phase the context for the text on sustainability has been expanded and better integrated with aspects of innovativeness.</p>
<p>Maps</p> <p>A standard map of the African continent is provided. More helpful would be details on the location of the proposed initial pilots in Uganda and the Shire (Malawi and Mozambique).</p>	<p>PPG phase:</p> <p>During the PPG phase maps have been added to Section 1.b as well as to the baseline Section.</p>

<p>Stakeholders</p> <p>The section on stakeholders outlines a history of prior engagement in this area.</p> <p>Given the continental reach, stakeholder identification is appropriately focused on regional institutions. However, if the pilot projects are to be successful it is likely that local communities and other non-government actors will need to be engaged through well-articulated objectives and incentives. Similarly, it will be important to understand how the various regional institutions are seen to interface with national government, civil society, and private sector actors. This merits further elaboration during PPG stage, at least through a few examples.</p> <p>Some additional information is provided for the pilot projects in the coordination section of the PIF.</p>	<p>The description of Component 1 outlines the focus on strengthening AMCOW's capacity to support national agencies in the context of groundwater management. Component 2 provides further evidence and tools at these levels. Component 3 operates for the three target sites at national and transboundary levels and will indeed involve stakeholders at sub-national level. For this an engagement strategy has been developed as shown in Section 2 and Annex I2.</p>
<p>Stakeholder's roles</p> <p>Continent-wide and regional organizations are well identified as stakeholders. It will be important to also identify stakeholders for the pilot projects in Southern Africa to include local communities, private sector partners (mentioned later in that section), NGOs, etc. to ensure that the pilots are well designed and accepted by people who will be impacted by them.</p>	<p>These points have been addressed during the PPG phase and are documented in Section 2 and Annex I2. Additional references to stakeholder engagement can be found in the activity descriptions under Component 3.</p>
<p>Risks</p> <p>The description of risks, while brief, appears to provide good coverage of a variety of environmental and institutional factors, though more information could be provided about climate risk. Please refer to STAP guidance on climate risk screening.</p> <p>Institutional capacity building investments often dissipate. The project would benefit from greater clarity on how African scientists and research institutions will be included in the pan-African assessment.</p>	<p>Section 5 on risks has been completely revised.</p> <p>A climate risk assessment has been conducted by FAO.</p> <p>More details were added to planned collaborative arrangements with other researchers, see page 88, 165, 169, 171, and 173.</p>
<p>Lessons-learned from earlier projects:</p> <p>Yes, though much more is needed to first identify earlier and ongoing projects in order to systematize the learning and knowledge exchange.</p>	<p>The baseline section provides an overview of earlier and ongoing projects. The alternative scenario describes how learning and knowledge exchange will be facilitated.</p>

<p>Knowledge Management:</p> <p>Knowledge capture and management is central to all aspects of this project, including the dedicated component as well as the strategy. However, most of the KM appears to be outward facing, as opposed to knowledge creating and sharing within projects, between countries, etc. Given the geographic breadth, this element is essential.</p> <p>Also absent from this section is detailed information about how knowledge and learning will be systematized within the project so that knowledge is not lost when staff leave or if support for the AMCOW groundwater desk is not sustained once this project has ended and if efforts to secure sustainable financing are not realized.</p>	<p>Knowledge management activities have been defined during the PPG phase, see narrative for Component 5. The project will also put strategies in place to sustain the learning at the national level as well as the level of AMCOW, see connections between Component 5, 2 and 1.</p>
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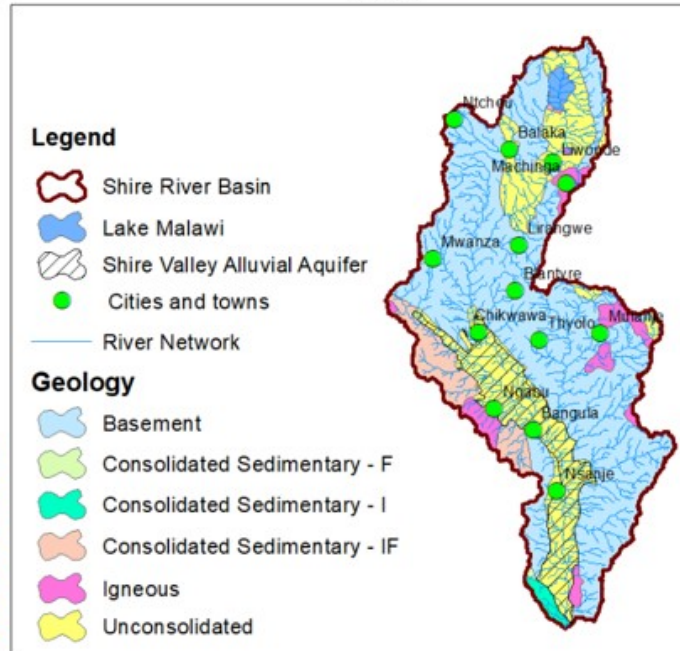
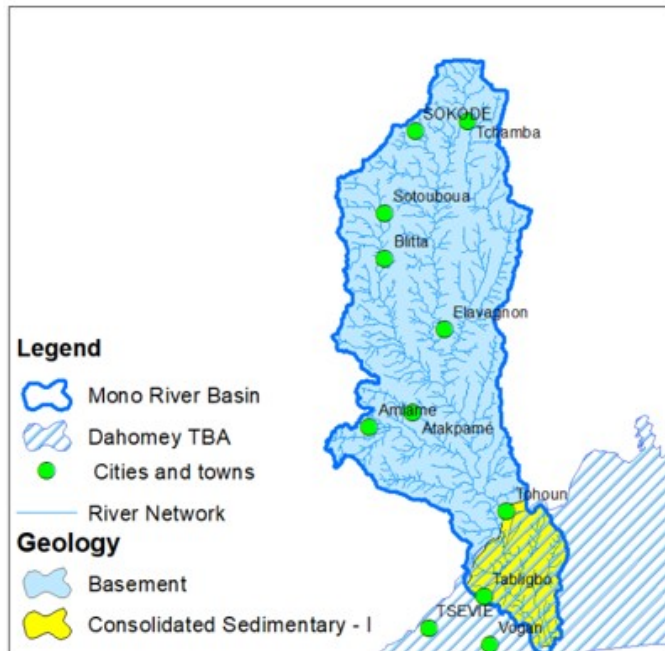
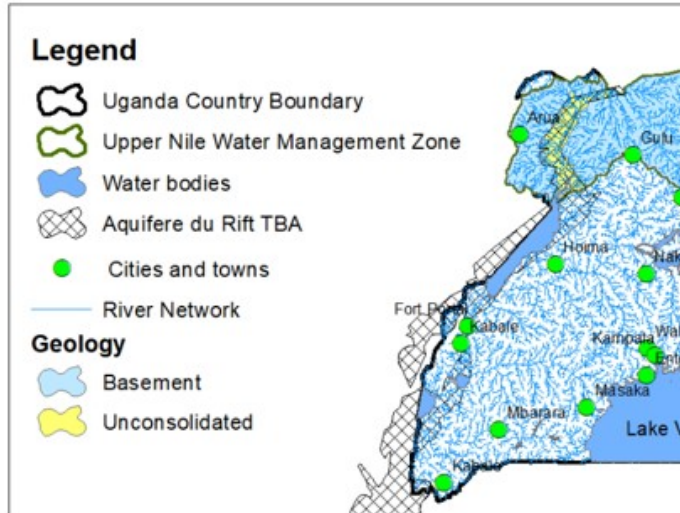
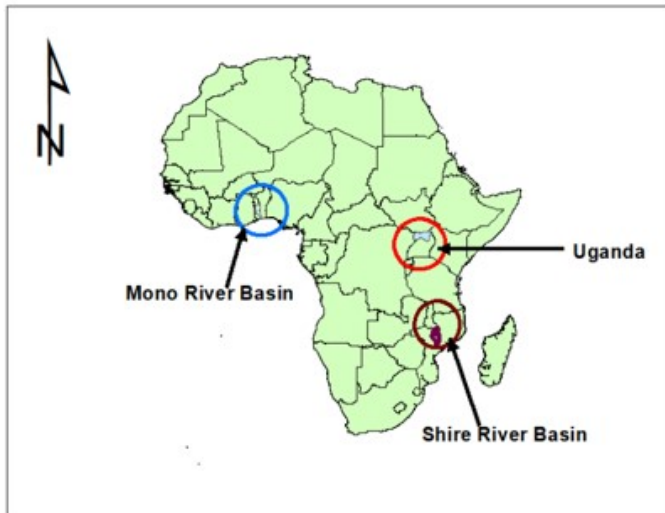
ANNEX C: Status of Utilization of Project Preparation Grant (PPG).
(Provide detailed funding amount of the PPG activities financing status in the table below:

PPG Grant Approved at PIF: USD 150,000			
<i>Project Preparation Activities Implemented</i>	<i>GETF/LDCF/SCCF Amount (\$)</i>		
	Budgeted Amount	Amount Spent to date	Amount Committed
<i>Salaries Professional</i>			
<i>Team Leader / Transboundary Groundwater Management Specialist (IWMI)</i>	28,000	21,000	7,000
<i>Groundwater Advisor (IWMI)</i>	1,440	1,440	-
<i>Gender and Inclusion Specialist (IWMI)</i>	3,500	10,500	(7,000)
<i>Admin, logistic and financial supporting staff (IWMI)</i>	7,660	6,260	1,400
<i>Financial Specialist (FAO)</i>	9,000	9,000	-
<i>Consultants</i>			

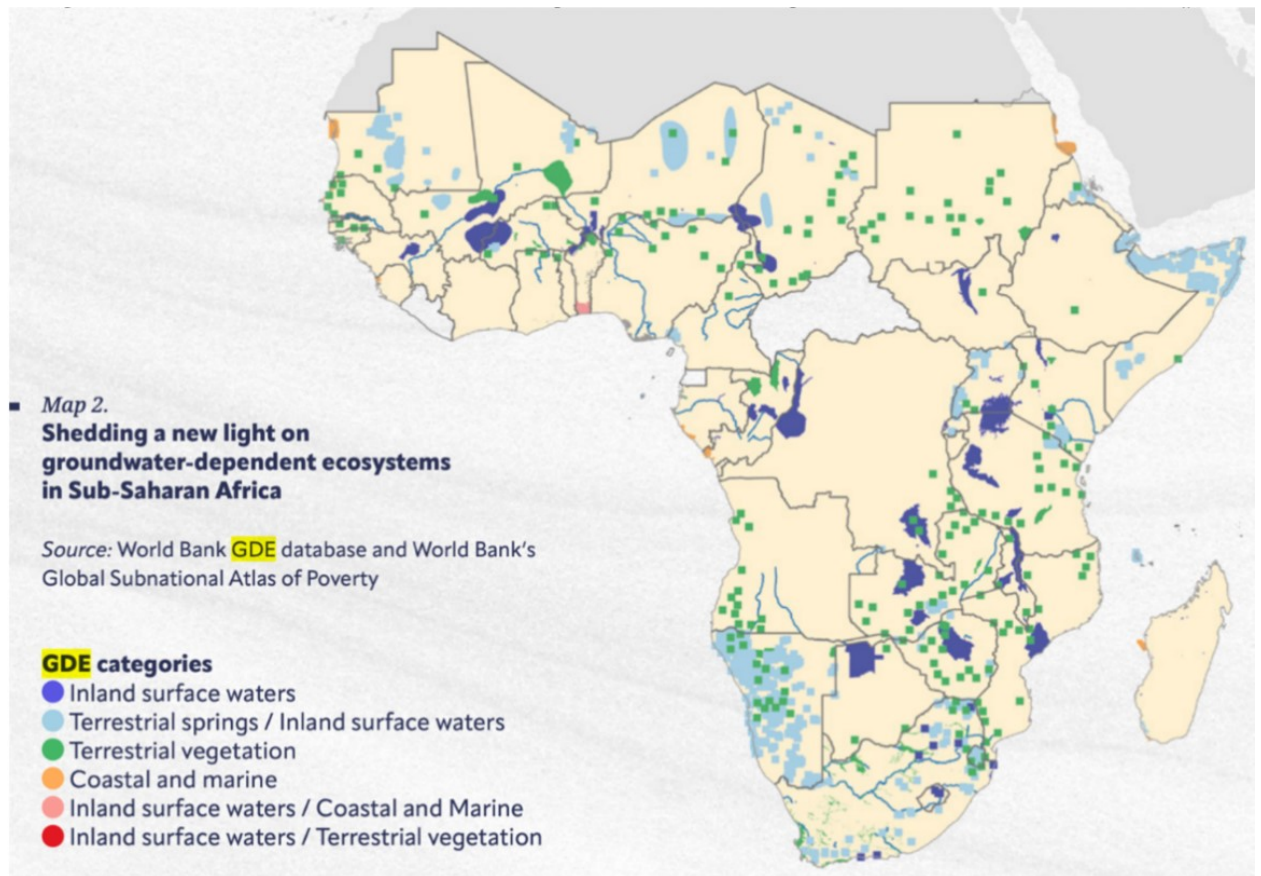
<i>National Consultant - Malawi</i>	6,000	6,000	-
<i>National Consultant - Mozambique</i>	6,000	5,000	1,000
<i>National Consultant - Uganda</i>	6,000	5,000	1,000
<i>Environmental Social Safeguard expert</i>	6,000	-	6,000
<i>GEF Writing consultant</i>	32,500	32,500	-
Contracts			
<i>Contract - IIASA</i>	18,000	18,000	-
Meeting/Workshops/Training			
<i>Workshops</i>	12,000	22,732	(10,732)
Travels			
<i>Travels, per diem and accommodation</i>	10,720	4,216	6,504
GOE			
<i>Office Rent and Utilities (IWMI)</i>	3,180	-	3,180
Total	150,000	141,648	8,352

ANNEX D: Project Map(s) and Coordinates

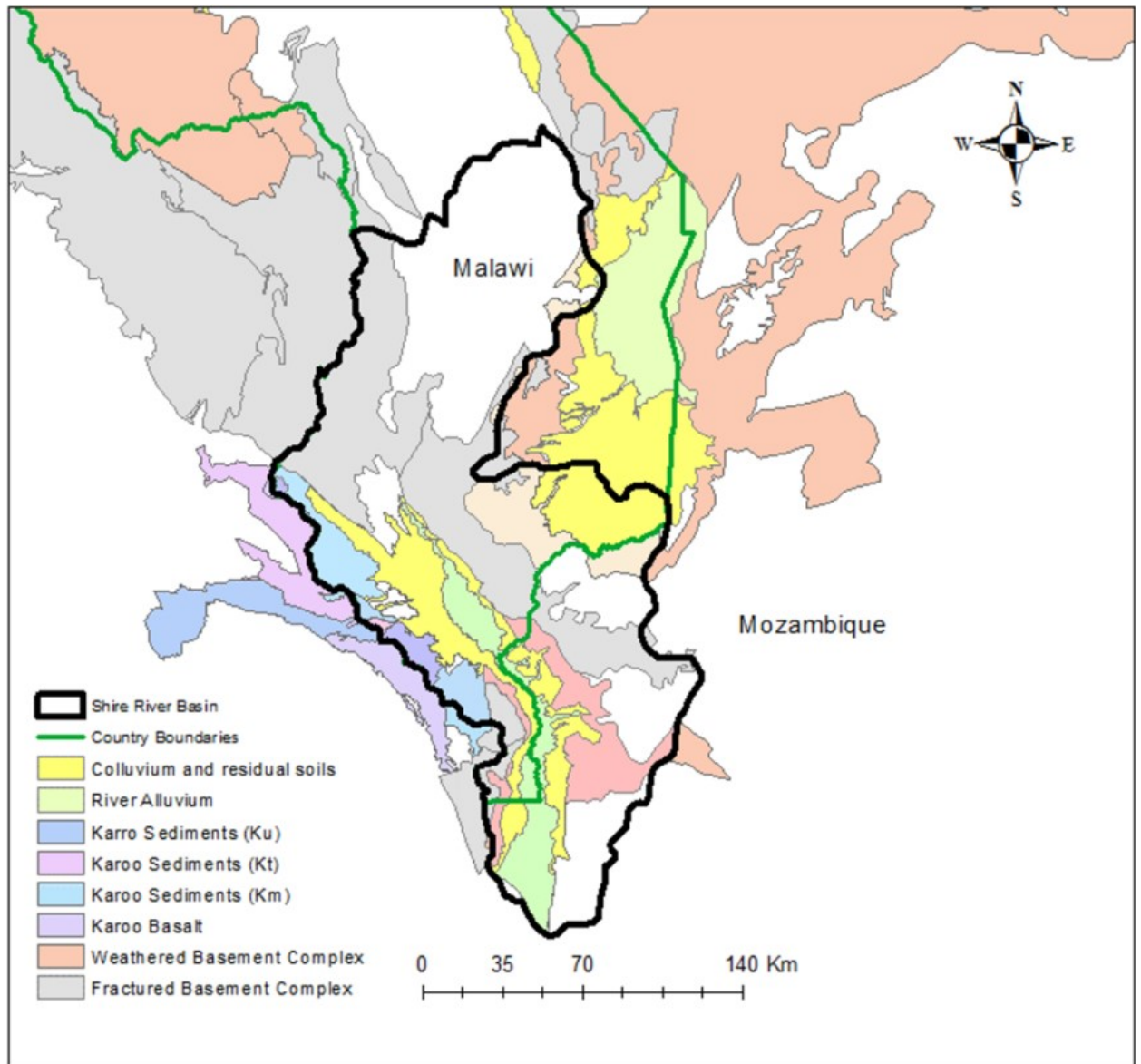
Please attach the geographical location of the project area, if possible.



Maps for Africa and for the three pilot areas are provided in Section 1.b.



Shire Aquifer: Hennings et al. (2016) provide geographic coordinates for the northern and southern boundaries of the aquifer, which are approximately 13.5°S to 16°S latitude and 34.5°E to 37°E longitude. However, the exact boundaries of the aquifer are not precisely defined due to limited data availability and the lack of systematic hydrogeological studies in the region.



Reference: Hennings, V., Kashaigili, J.J., Kukuric, N., Reimann, T., & Sauter, M. (2016). The potential of geophysics for the assessment and management of transboundary aquifers in Sub-Saharan Africa: A case study of the Shire Basin aquifer. *Water Resources Management*, 30(15), 5573-5590.

Uganda: According to the US Central Intelligence Agency (CIA) World Factbook, the geographic coordinates for the boundaries of Uganda are approximately:

? Northernmost point: 4.2206° N, 33.9089° E

? Southernmost point: 0.4261° S, 29.5735° E

? Easternmost point: 4.2206° N, 35.0350° E

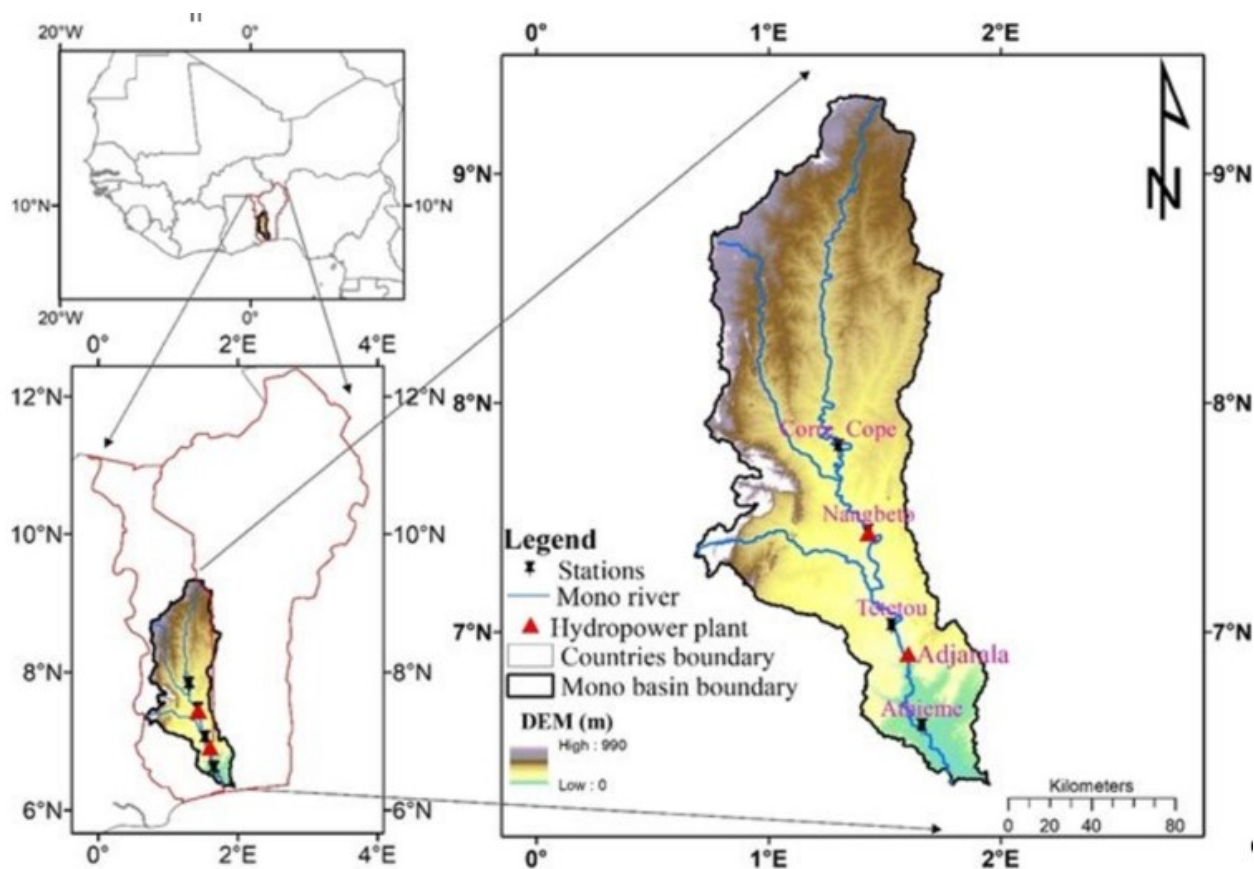
? Westernmost point: 1.4777° S, 29.5735° E



Mono River basin: The approximate geographic coordinates for the basin are:

? Latitude: 7.2115° N to 10.2605° N

? Longitude: 0.0717° E to 2.5569° E



Map of Case Studies Geological layers are obtained from BGS. Abbreviations used in the legend represent dominantly fractured flow (F), dominantly intergranular flow (I), and mixed flow (IF).

GEO LOCATION INFORMATION

The Location Name, Latitude and Longitude are required fields insofar as an Agency chooses to enter a project location under the set format. The Geo Name ID is required in instances where the location is not exact, such as in the case of a city, as opposed to the exact site of a physical infrastructure. These IDs are available on the [GeoNames? geographical database](#) containing millions of placenames and allowing to freely record new ones. The Location & Activity Description fields are optional. Project longitude and latitude must follow the Decimal Degrees WGS84 format and Agencies are encouraged to use at least four decimal points for greater accuracy. Users may add as many locations as appropriate. Web mapping applications such as [OpenStreetMap](#) or [GeoNames](#) use this format. Consider using a conversion tool as needed, such as: <https://coordinates-converter.com> Please see the Geocoding User Guide by clicking [here](#).

Location Name	Latitude	Longitude	Geo Name ID	Location & Activity Description
Mono River	6.2302	1.6065		<input type="checkbox"/>
Dahomey Transboundary Aquifer inside Mono River Basin	6.279167	1.400000		<input type="checkbox"/>
Upper Nile Water Management Zone, Uganda	3.024471	32.740766		<input type="checkbox"/>
Aquifere du Rift Transboundary Aquifer inside the Upper Nile Water Management Zone, Uganda	2.70000	31.138841		<input type="checkbox"/>
Shire River Basin	-17.695833	34.245833		<input type="checkbox"/>
Shire Alluvial Transboundary Aquifer	-17.669856	34.403120		<input type="checkbox"/>

ANNEX E: Project Budget Table

Please attach a project budget table.

10970 GEF ID

Budget Holder	FAO Cost Categories	Component 1	Component 2	Component 3	Component 4	Component 5		PMC	Total	Year 1	Year 2
		Total	Total	Total	Total	M&E	Total				
	5011 Salaries professionals										
IWMI	Chief Technical Advisor	140,000	10,000	102,336	10,000	-	20,000	83,664	366,000	54,900	73,000
IWMI	Transboundary Groundwater Specialist	-	-	202,000	-	-	-	-	202,000	30,300	40,000
IWMI	Hydrologist	-	-	110,000	-	-	-	-	110,000	16,500	22,000
IWMI	Gender and Social Inclusion Specialist	45,000	-	50,000	100,000	-	15,000	-	210,000	31,500	42,000
IWMI	Financial Support Officers	-	-	-	-	-	-	73,550	73,550	11,033	14,000
	5011 Sub-total salaries professionals	185,000	10,000	464,336	110,000	-	35,000	157,214	961,550	144,233	192,000
	5013 Consultants										
IWMI	International Monitoring and Evaluation Specialist	40,000	-	-	-	20,000	20,000	-	60,000	9,000	12,000
IWMI	International stakeholder engagement specialist	-	-	-	-	20,000	20,000	-	20,000	3,000	4,000
IWMI	International consultant to develop communications plan and knowledge management plan	-	-	-	-	13,000	33,000	-	33,000	4,950	6,000
IWMI	Regional Consultant (SADC) - Component 3.4 Advisor	-	-	33,000	-	-	-	-	33,000	4,950	6,000
IWMI	International Water Quality Specialist	-	-	35,000	-	-	-	-	35,000	5,250	7,000
	Sub-total international Consultants	40,000	-	68,000	-	53,000	73,000	-	181,000	27,150	36,000
IWMI	National Groundwater and Network Monitoring Coordinator Mozambique	-	-	100,000	-	-	-	-	100,000	15,000	20,000
IWMI	National Groundwater and Network Monitoring Coordinator Mono Basin	-	-	125,000	-	-	-	-	125,000	18,750	25,000
IWMI	National Groundwater and Network Monitoring Coordinator Malawi	-	-	100,000	-	-	-	-	100,000	15,000	20,000
IWMI	Technical Support Expert	100,000	-	40,000	16,000	-	9,000	24,000	189,000	28,350	37,000
IWMI	National Knowledge Management Expert	-	-	20,000	10,000	-	30,000	-	60,000	9,000	12,000
IWMI	National Consultants for Water and Sanitation Infrastructure assessment	-	-	45,000	-	-	-	-	45,000	6,750	9,000
IWMI	National Consultants youth network framework development	-	-	-	37,500	-	-	-	37,500	5,625	7,500
IWMI	National Youth outreach ambassadors	-	-	-	10,000	-	-	-	10,000	1,500	2,000
	Sub-total national Consultants	100,000	-	430,000	73,500	-	39,000	24,000	666,500	99,975	133,000
	5013 Sub-total consultants	140,000	-	498,000	73,500	53,000	112,000	24,000	847,500	127,125	169,000
	5650 Contracts										
FAO	Terminal Evaluation	-	-	-	-	75,000	75,000	-	75,000	11,250	15,000
FAO	Terminal Report	-	-	-	-	7,000	7,000	-	7,000	1,050	1,000
FAO	Mid term Review (MTR)	-	-	-	-	50,000	50,000	-	50,000	7,500	10,000
FAO	Audits	-	-	-	-	-	-	28,000	28,000	4,200	5,000
FAO	Spot-checks	-	-	-	-	17,664	17,664	-	17,664	2,650	3,000
AMCOW	Contract with AMCOW Component 1	1,002,250	-	-	-	-	-	-	1,002,250	150,338	200,000
IIASA	Contract with IIASA for Components 2 and 3	-	700,000	700,000	-	-	-	-	1,400,000	210,000	280,000
IWMI	Contract for Hydro-census field surveys - Malawi and Mozambique	-	-	40,000	-	-	-	-	40,000	6,000	8,000
IWMI	Contract to develop groundwater monitoring network	-	-	80,000	-	-	-	-	80,000	12,000	16,000
IWMI	Contract to SADC-GMI for Drilling of boreholes	-	-	120,000	-	-	-	-	120,000	18,000	24,000
IWMI	Contract for Rehabilitation of wells, installation of data loggers, water quality samling and analysis, etc.	-	-	220,000	-	-	-	-	220,000	33,000	44,000
IWMI	Contract for diagnostic to identify existing drinking water and sanitation infrastructure	-	-	60,000	-	-	-	-	60,000	9,000	12,000
IWMI	Contract for rehabilitation and protection of drinking water and sanitation infrastructure under flood risk	-	-	100,000	-	-	-	-	100,000	15,000	20,000
	5650 Sub-total Contracts	1,002,250	700,000	1,320,000	-	149,664	149,664	28,000	3,199,914	479,987	639,000
	5021 Travel										
IWMI	International Travel	-	-	75,000	20,000	30,000	30,000	-	125,000	18,750	25,000
IWMI	National Travel	-	-	60,000	20,000	-	5,000	-	85,000	12,750	17,000
IWMI	Other Travel (training/workshops, meetings, portion of the 1% IW LEARN, Study Tours)	-	-	-	-	-	40,000	-	40,000	6,000	8,000
	5021 Sub-total travel	-	-	135,000	40,000	30,000	75,000	-	250,000	37,500	50,000
	5023 Training										
IWMI	IW LEARN (portion of the 1% IW LEARN, training publications, workshop participation and materials)	-	-	-	-	-	60,000	-	60,000	9,000	12,000
IWMI	National / Local Workshops	-	-	50,000	10,000	-	10,000	-	70,000	10,500	14,000
IWMI	International / Regional Workshops / PSC	-	-	-	15,000	40,000	40,000	-	55,000	8,250	11,000
IWMI	Conducting study tours and peer-to-peer exchanges	-	-	40,000	-	-	-	-	40,000	6,000	8,000
IWMI	Collaborative workshops/meetings with representatives of various youth forums	-	-	-	40,000	-	-	-	40,000	6,000	8,000
	5023 Sub-total training	-	-	90,000	65,000	40,000	110,000	-	265,000	39,750	53,000
	5024 Expendable procurement										
IWMI	Publication, reports, promotion and extension materials, Stationary (papers, ink), Publication for training, reports, promotion and extension materials, Information and promotion material, printing document cost, public document to promote the project	20,000	-	34,000	2,000	-	8,000	-	64,000	9,600	12,000
	5024 Sub-total expendable procurement	20,000	-	34,000	2,000	-	8,000	-	64,000	9,600	12,000
	6100 Non-expendable procurement										
IWMI	Technical equipment for: data loggers and software and cloud storage cost	-	-	115,000	-	-	-	-	115,000	17,250	23,000
IWMI	ICT (Computers, printers, ICT Support) - partial cofinanced	6,808	-	8,000	2,000	-	-	-	16,808	2,521	3,000
	6100 Sub-total non-expendable procurement	6,808	-	123,000	2,000	-	-	-	131,808	19,771	26,000
	5028 GOE budget										
IWMI	Project office, utilities and supplies (IWMI and SADC) - partially cofinanced	-	-	-	-	-	-	66,301	66,301	9,945.18	13,260.00

ANNEX F: (For NGI only) Termsheet

Instructions. Please submit an finalized termsheet in this section. The NGI Program Call for Proposals provided a template in Annex A of the Call for Proposals that can be used by the Agency. Agencies can use their own termsheets but must add sections on Currency Risk, Co-financing Ratio and Financial Additionality as defined in the template provided in Annex A of the Call for proposals. Termsheets submitted at CEO endorsement stage should include final terms and conditions of the financing.

N/A

ANNEX G: (For NGI only) Reflows

Instructions. Please submit a reflows table as provided in Annex B of the NGI Program Call for Proposals and the Trustee excel sheet for reflows (as provided by the Secretariat or the Trustee) in the Document Section of the CEO endorsement. The Agency is required to quantify any expected financial return/gains/interests earned on non-grant instruments that will be transferred to the GEF Trust Fund as noted in the Guidelines on the Project and Program Cycle Policy. Partner Agencies will be required to comply with the reflows procedures established in their respective Financial Procedures Agreement with the GEF Trustee. Agencies are welcomed to provide assumptions that explain expected financial reflow schedules.

N/A

ANNEX H: (For NGI only) Agency Capacity to generate reflows

Instructions. The GEF Agency submitting the CEO endorsement request is required to respond to any questions raised as part of the PIF review process that required clarifications on the Agency Capacity to manage reflows. This Annex seeks to demonstrate Agencies' capacity and eligibility to administer NGI resources as established in the Guidelines on the Project and Program Cycle Policy, GEF/C.52/Inf.06/Rev.01, June 9, 2017 (Annex 5).

N/A