PEACE, PROSPERITY AND
REGIONAL INTEGRATION

**HORN OF AFRICA - GROUNDWATER FOR RESILIENCE PROJECT (P174867)**

# TERMS OF REFERENCE

# FEASIBILITY STUDY FOR GROUNDWATER DEVELOPMENT AND MANAGEMENT IN THE DAWA TRANSBOUNDARY AQUIFER

**(SHARED BETWEEN ETHIOPIA, KENYA AND SOMALIA)**

**IGAD – Water Unit**

**February, 2023**

# Abbreviations & Acronyms

| | |
|---|---|
| AMP | Aquifer Management Plan |
| DEM | Digital Elevation Model |
| DSS | Decision Support System |
| ESMF | Environmental and Social Management Framework |
| ESS | Environmental and Social Standards |
| GW | Groundwater |
| ICPAC | IGAD's Climate Prediction and Applications Centre[1] |
| IGAD | Intergovernmental Authority on Development |
| IGAD-GWC | IGAD Groundwater Centre[2] |
| IGAD-GWIS | IGAD Groundwater Information System |
| IWU | IGAD Water Unit[3] |
| HoA | Horn of Africa |
| HoA-GW4R | Horn of Africa – Groundwater for Resilience Project |
| GIS | Geographic Information System |
| KSFG | Key Stakeholder Focus Group |
| MAR | Managed Aquifer Recharge |
| MPA | Multi-Phase Approach |
| MS | IGAD Member State |
| PDO | Project Development Objective |
| PGWC | Platform for Groundwater Collaboration |
| SEP | Stakeholder Engagement Plan |
| TBA | Transboundary aquifer |
| WB | World Bank |

[1] Based in Nairobi, Kenya
[2] Based in Nairobi, Kenya
[3] Based in Djibouti, Djibouti

# Table of Contents

# 1. Introduction

The Horn of Africa Groundwater for Resilience (HoA GW4R) Program aims to increase sustainable access and management of groundwater (GW) in the Horn of Africa as a key contribution to strengthen the climate resilience of targeted communities, using the Multiphase Programmatic Approach (MPA). The Program has one overarching development objective and a common structure for the connected projects. The Project Development Objective (PDO) is to increase groundwater's sustainable access and management in the Horn of Africa's borderlands. Three countries, the Federal Democratic Republic of Ethiopia, the Republic of Kenya, the Federal Republic of Somalia, and the Intergovernmental Authority on Development (IGAD), are included in the current Project (P174867) which constitutes Phase I of the Regional Program.

IGAD's component of the Project aims to increase the sustainable use and management of groundwater in the Horn of Africa through the strengthening of regional information, capacity and collaboration. The progress to the PDO will be measured by the following outcome indicator: regional groundwater institutions with increased access to improved information critical for sustainable GW management. Intermediate indicators include, among others: (a) new policies, bylaws, regulations, guidelines or regional agreements prepared or adapted for sustainable groundwater management and use in participating countries, (b) Horn of Africa Groundwater Information System (HoA-GWIS) established and operational, and (c) Regional Platform for Groundwater Collaboration (PGWC) functioning among participating countries. The HoA-GWIS will be essential for sustainable GW management as it will allow countries to generate and share data on transboundary aquifers, adding value to inform decision-making and joint planning. The PGWC will serve as a key collaborative mechanism among IGAD and Member States (MS) to agree on and prioritize joint groundwater activities, decide on their scope and modalities, and support the implementation and validation of regional outputs.

The primary project beneficiaries will be decision-makers, civil servants, and groundwater management professionals of regional and national institutions involved in the planning, development and management of groundwater resources in the IGAD region, through strengthened capacity, increased availability of relevant information, improved policies and strengthened regional collaboration. The project will also benefit scientists and experts of universities, professional institutions and companies in the region that work on groundwater at the transboundary, national, and sub-national levels and indirectly also the inhabitants of the IGAD region that will benefit from more sustainable groundwater management and increased resilience to climate shocks.

The project is implemented by IGAD's Water Unit (IWU) with technical support and guidance from the IGAD Groundwater Centre (IGAD-GWC), housed at ICPAC[4] in Nairobi, and has a duration of 6 and half years. It's structured around the three following components:

**Component 1**. Strengthening Regional Capacity & Information for Sustainable Groundwater Management

**Component 2**. Promoting Regional Integration and Collaboration

**Component 3**. Regional Program Coordination, Monitoring & Evaluation

The second component of the project will promote regional integration policies, guidelines and standards for groundwater development and management, and support enhanced collaboration in the study, planning and management of shared groundwater resources in the HoA.

[4] IGAD'S Climate Prediction and Applications Centre (ICPAC) is a Climate Center accredited by the World Meteorological Organization that provides Climate Services to 11 East African Countries.

One of the main activities under the second component is the evaluation of the potential of a selected number of transboundary aquifers in the IGAD region. This will be achieved through consulting services which will undertake feasibility studies on three aquifers in the region, these ToR comprising one of these.

## 2. Objectives of the study

The objective of this work is to undertake a feasibility study on the Dawa[5] Transboundary aquifer system (shared between Ethiopia, Kenya and Somalia) in order to: a) compile and complement the knowledge of the aquifer, and assess key data gaps, b) assess the availability and variability of surface water and groundwater resources and their vulnerability to climate change, and evaluate the uncertainties related to these assessments, c) provide preliminary plans for developing water-related infrastructure for socio-economic development and d) develop an Aquifer Management Plan (AMP) and Decision Support System (DSS) for the Dawa aquifer. This feasibility study will also establish recommendations and guidelines for future groundwater exploration, management, and protection and assess associated environmental and social risks and mitigation measures. Water infrastructure developments in shared aquifers provide a huge potential in promoting cooperation among the shared water resource users.

## 3. Study Area

The Dawa Aquifer is a multi-layered and partly confined aquifer system shared by Ethiopia, Somalia and Kenya, covering an estimated area of 31,000 km2 with 370,000 inhabitants[6] (Fig 1). The aquifer is predominantly composed of sedimentary rocks, including fractured limestones and gravel deposits. It receives an average annual rainfall of 300–650 mm and has a low annual water recharge rate, in the range of 10 to 20 mm/year only[7]. Current groundwater abstractions are expected to represent only a few percent of the available resource[8]. The groundwater potential in the aquifer varies, with a greater quantity of resources in Ethiopia. The Dawa Aquifer is recharged during periods of high river discharge, and in some areas can be tapped through shallow wells. Because the aquifer is covered by medium- to coarse-sized sediments and volcanic rocks, it is an important groundwater reservoir for local communities.

The study area comprises the geographical area covered by the aquifer and adjacent areas that are hydraulically connected to it. The hydrometeorological assessments will also include those parts of surface water catchments intersecting with the aquifer area that are located outside the aquifer area.

[5] In Somalia the aquifer is generally referred to as Daawa and in Ethiopia as Daua.

[6] TWAP Transboundary Aquifer Information sheet AF43-Dawa, version September 2015 (www.un-igrac.org)

[7] Hydrogeological Map of Africa at 1/10M scale (BRGM-UNESCO, 2008)

[8] TWAP Transboundary Aquifer Information sheet AF43-Dawa, version September 2015 (www.un-igrac.org)

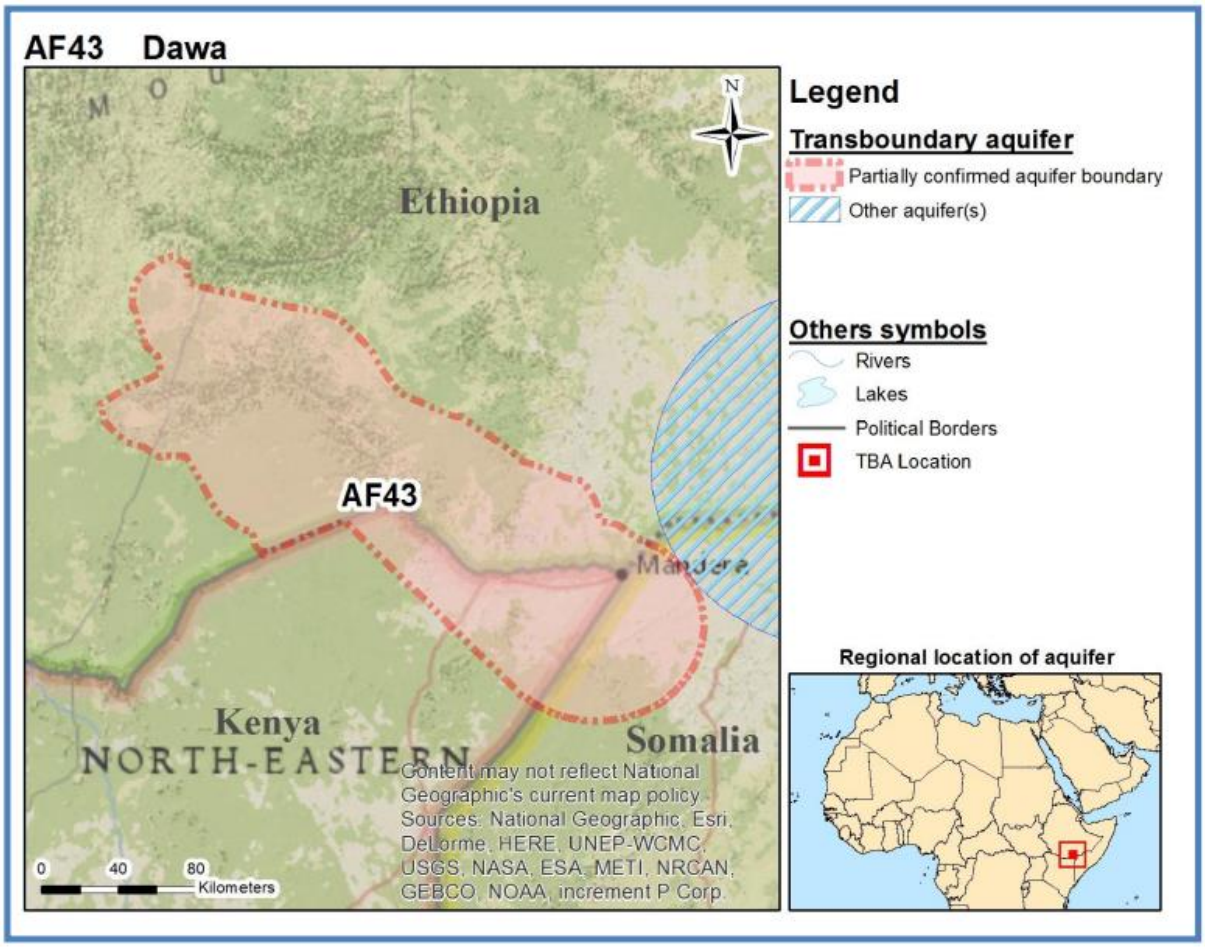


*Figure 1: Approximate delineation of the Dawa Transboundary Aquifer (source: TWAP Transboundary Aquifer Information sheet AF43-Dawa)*

## 4. Methodology

The Consultant will be expected to employ the most effective methodology and standards to achieve results with optimal national stakeholder involvement. The level of groundwater information varies from one country to another but is expected to be limited. The Consultant will be expected to: (i) collect for review and analysis available data and information relevant to the understanding of the aquifer and it's dynamics, including existing secondary sources of information such as assessment reports and various other regional and relevant global publications, targeted field data for critical assessments and extensively use complementary satellite-based data products that will enhance the quality of necessary meteorological, hydrological and hydrogeological assessments, (ii) conduct site visits for data verification and organize workshops for stakeholder interaction, (iii) prepare technical designs for water harvesting and groundwater and (iv) develop, in consultation with the riparian countries, aquifer management, monitoring and development plans. Considering that the volume of historical records and ground data is expected to be limited the Consultant Proposal shall clearly explain how the surface water and groundwater potentials are proposed to be assessed (under Task 2 in the Scope of Work described below), as resource availability and variability will be a critical input for Tasks 3 and 4 of the Project. A summary of available reference documentation is attached as Annex 1.

# 5. Scope of Work

The Scope of work is divided in 4 main Tasks, as shown in Figure 2 below. It includes the following tasks:

## TASK 1 DESK STUDY & AQUIFER DELINEATION

### Task 1.1 Focus meeting with National Stakeholders

The first task of this feasibility study is to organize a workshop with key stakeholders of the Dawa Aquifer from the 3 riparian countries Ethiopia, Kenya and Somalia[9] and representatives from IGAD (IWU, IGAD-GWC and ICPAC). Objective of the workshop is to present and discuss the study with to the Key Stakeholder Focus Group (KSFG), a focus group of experts and decision-makers from the 3 riparian countries, to assess the state of knowledge on the aquifer, its current uses and relevant developments and issues. Ahead of the meeting the Consultant shall prepare a set of questionnaires related to availability and accessibility of data and information, needed to assess the available groundwater resource of the Dawa transboundary aquifer. This meeting will be an opportunity to discuss and interact with the stakeholders panel on the following points:

- Existing sources of important hydro(geo)logical data and information for water resources assessment (meteorological and hydrological data, borehole and pumping test data, piezometric and groundwater quality data, geophysical surveys, water point inventories, geological maps, etc.);
- State of knowledge on the vertical and lateral extension of the Dawa aquifer and the local knowledge on aquifer characteristics;
- Knowledge on current groundwater uses, projected uses and existing sectoral development plans for the Dawa aquifer;
- Quality and availability of local expertise in groundwater exploration, siting, drilling and water point maintenance.

### Task 1.2 Collect and review available data and information

The Consultant will complement the list of reports and other information sources provided by IGAD and national stakeholders with data/information from public/online sources. This will include (i) data on climate, hydrology, groundwater and hydrogeology, topography, soils, etc, including satellite-based meteorological and hydro(geo)logical data products to complement/validate sparse ground data and provide historic and seasonal perspectives on local hydro(geo)logical dynamics and aquifer-wide environmental and social baseline conditions (ii) socio-economic data (on population, land use, industry, agriculture, pastoralism, etc.), (iii) reports on earlier groundwater and water buffering (feasibility) studies and projects and (iv) information on the legal and regulatory status of water management and related (national and basin level) plans and policies. Information on existing wells, groundwater abstractions, groundwater levels and quality and well drilling experiences in the TBA (including possibility for testing of existing wells) are of particular interest. The Consultant will collect and review all available information and organize and store collected groundwater relevant data in a GIS.

[9] Riparian countries will be invited to nominate members for the Key Stakeholder Focus Group (KSFG), composed of decision makers and groundwater experts from the 3 countries, who remain involved and will be consulted through all phases of the Project. The KSFG will ensure that stakeholder consultations under this study will be undertaken in coordination with and in accordance with the provisions of the Stakeholder Engagement Plans (SEP) of the Groundwater for Resilience Projects in the riparian Member States.

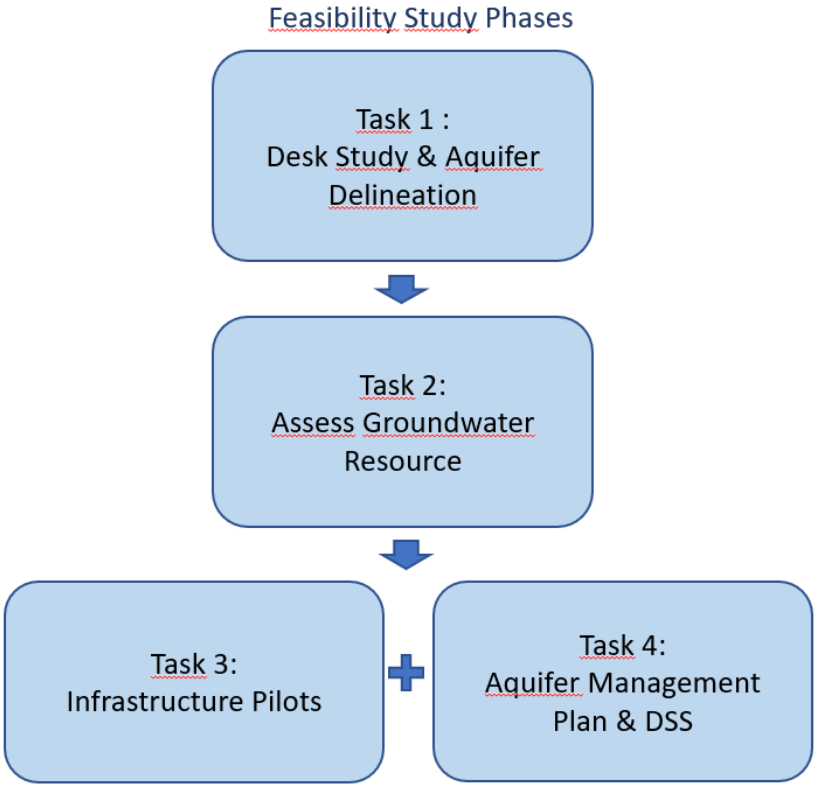


*Figure 2: Structure of the Scope of Work*

**Task 1.3. Asses the main hydrological and hydrogeological conditions.**

Based on the information collected under Task 1.2: prepare an overview of the state of knowledge on and describe the meteorological and hydro(geo)logical conditions, shallow and deep groundwater bodies, aquifer geometry, characteristics and dynamics, recharge rates and surface water interactions. Assess the knowledge on storage characteristics, economic reserves, groundwater uses and susceptibility to aquifer/ecosystem degradation and identify key knowledge gaps on aquifer boundaries, groundwater reserves and renewal rates. Prepare an overview of existing water buffering/MAR[10] interventions, experiences and its potential for further upscaling.

**Task 1.4 Assess water use and demand & Map key stakeholders**

Based on collected data, reports and public data sets assess current and projected surface and groundwater uses in the project area for human and animal consumption, agriculture, industrial or energy uses. Attention will also be paid to assess currently unmet demand, variability of demand along transhumance corridors and the special needs of refugee populations. Describe the current status and planning of rural and (small) town drinking water supply, including for refugee camps, and for livestock and irrigation water supply. Assess developments in land use change and identify water related development plans such as for irrigated agriculture, flower farming, industrial development, mining and infrastructure development. Identify critical environmental water needs, including for wildlife, maintenance of biodiversity or environmentally critical areas like wetlands.

[10]Managed Aquifer Recharge

Based on collected data, population data and projections and identified developments assess the current and projected water uses for the horizon 2025- 2040. Identify any areas where current or projected water uses may lead to unsustainable resource use.

Based on information provided by national stakeholders and other sources, including the Stakeholder Engagement Plans (SEP) in the riparian countries, prepare for each of the riparian countries an overview of the stakeholders involved in groundwater use, development, study, management and protection and their specific role(s) therein. This will cover institutions at the National, County and District level, or their equivalent, scientific institutions, NGOs, water user associations and others. Make an analysis of groundwater user categories and their profiles. Special attention should be given to refugee and nomadic populations. This task will also include an assessment of the private sector involved in infrastructure development including the drilling sector and its capacity (and cost) to drill wells in the area (exploration wells, production wells monitoring wells). Any other technology used to enhance the development of the groundwater (MAR, sand dams, …) should also be assessed

### Task 1.5 Conduct field checks and stakeholder meetings.

During this phase of the project the Consultant shall organize field visits[11] to the project areas within the 3 riparian countries to verify key hydrogeological features and issues, including any information or knowledge related to the extension of the aquifer, verify prevailing geological, hydrological, geomorphological and soil conditions for water harvesting, inspect existing groundwater infrastructure and organize, in consultation with the KSFG and in compliance with the provisions of the SEPs of the riparian countries, stakeholder meetings to learn about existing groundwater use conditions, challenges, operation & maintenance arrangements, user conflicts and assess familiarity with and demand for infrastructure options.

The objectives of the field visits are to:

(i) collect ground information to verify relevant hydro-morphological, hydrogeological and geological features, including those relevant for the delineation of the aquifer, to confirm or /and update collected information on boreholes, other water related infrastructure or the use of groundwater, to check potential target areas for groundwater development and to validate environmental and social information and data collected;

(ii) consult the various stakeholders to:

- validate stakeholder roles;
- compile local knowledge on groundwater availability, seasonality and quality;
- identify predominant groundwater infrastructure options and their robustness to drought and the main drivers and constraints for groundwater use (including energy cost, access to technology, supply security, capacity…);
- collect information on existing practices with regard to water rights, permits and pricing, on water point access, use and maintenance and existing mechanisms for stakeholder consultation;
- assess current E&S management practices in the aquifer and key E&S issues;
- assess the occurrence of water use conflicts such as between farmers and herders, or between different pastoralist groups, around issues of contested land use or access to water and fodder.

[11] As permitted by the safety situation on the ground

Prior to the campaign, the Consultant shall arrange meetings with the TBA managers of the 3 riparian countries and IWU to plan the fieldwork program, discuss accessibility and security issues and agree on data access and sharing.

### Task 1.6 Propose lateral and vertical boundaries of the Transboundary Aquifer

Based on the review of all collected information, discussions with experts from the riparian countries, consultations with regional and international scientists, field checks and satellite imagery the Consultant will propose:

- The geological formations, members or features (such as dykes) that form part of the aquifer system;
- Its underlying and/or confining layers;
- The tentative geographical aquifer boundaries in the three riparian countries.

Any proposed extension or reduction of the boundary of Dawa aquifer as depicted in Figure 1 should be supported with evidence (borehole data, groundwater chemistry, field evidence, …)

The Consultant shall also report any differences of opinion among experts and major uncertainties with respect to the extent of the aquifer.

### Task 1.7 Develop a Conceptual Model of the Transboundary Aquifer System

Based on the analysis of all available information and consultations with scientists and experts from the 3 riparian countries, the Consultant will develop a conceptual model of the transboundary aquifer system, including its main hydrogeological units, recharge and discharge mechanisms and zones, groundwater flow patterns, hydrogeochemical characteristics, possible deep and shallow groundwater interactions and its seasonal and long-term dynamics The conceptual model will be based on cross-sectional analysis of existing borehole data and also include a characterization of the aquifer boundaries (horizontal and vertical) and proposed boundary conditions.

Along with the conceptual model the Consultant will compile current knowledge and estimates of the aquifer water balance components and groundwater resource potential and its distribution across the aquifer and propose a tentative water balance for the Dawa aquifer system. The Consultant will also identify priorities for data collection to complement key information gaps.

### Task 1.8 Prepare an overview of the policy, legislative and regulatory frameworks

This task includes the preparation of an overview of the policies, legislation and regulatory frameworks for water resources management in the riparian countries relevant for the Dawa aquifer. To accomplish this task, it is important to include for all countries also the status of legislation, policies and regulations regarding groundwater exploration, development and use and their level of application. Particular attention should be paid to existing regulations on and status of cooperation at the regional level. The Consultant shall also briefly discuss the legal and institutional framework in the riparian countries for E&S management (including the World Bank's framework) and identify regulatory requirements in the riparian countries for appraisal and implementation of interventions in the aquifer.

Based on the review of existing legislation and regulation, and in consultation with IGAD and stakeholders from the riparian countries, the Consultant shall then develop a draft framework for cross-border cooperation and management. This framework will be specific for the collaboration and data sharing mechanisms necessary for the achievement of the Project objectives but will serve as basis of future collaboration. This Framework shall also establish linkage with the Project E&S instruments of the riparian countries (ESMF, RF, SEP) including approach for application of the instruments for shared (cross border) groundwater development interventions.

### Task 1.9 Submit Desk Study Report

The desk study report shall present a compilation of all collected data on the defined study area, including in tables, graphs and maps, covering all aspects of the Dawa transboundary aquifer. The Desk Study Report shall describe the physical, climatological, hydro(geo)logical, socio-economic and environmental conditions in the aquifer region and present a conceptual model of the Dawa aquifer system and its proposed boundaries. The report shall also present a conceptual model of the Dawa aquifer system and provide a tentative water balance.

The report shall provide a description of the current and projected groundwater uses and identify potential negative social or environmental impacts, with special attention for any possible transboundary impacts. The Report shall describe main groundwater users and stakeholder groups in the 3 riparian countries and existing legal & regulatory frameworks.

Upon finalization of the draft Desk Study Report, a physical validation workshop will be organized in order to present the preliminary results and discuss key findings of the study with the KSFG and IGAD.

Before finalization the final Desk Study Report will incorporate the consolidated comments and feedback from the validation workshop and IGAD, including on the proposed aquifer extension, conceptual model and draft framework for cross-border cooperation and management.

## TASK 2 GROUNDWATER RESOURCE ASSESSMENT

### Task 2.1 Evaluate surface water availability & variability

The Consultant will use available historical satellite-based meteorological and hydrological raster data sets and products to assess, in combination with available meteorological data records from the region, trends and patterns of rainfall, actual evapotranspiration, effective rainfall, soil moisture, water storage, etc. across the study area, and evaluate their intra-annual and inter-annual variability. Results from similar ongoing or completed studies should be consulted and used where possible. Based on a DEM and other global datasets the Consultant will map hydrological basins, sub-basins and catchments, water courses, drainage channels and water accumulation areas of endorheic catchments. Considering meteorological, hydrological, soil moisture, vegetation and other satellite-based data products, the Consultant will then assess surface water availability and variability in the catchments intersecting with the aquifer and its recharge and discharge areas. Special attention will be given to the analysis of changes in the frequency, duration and intensity of drought conditions and surface water availability.

### Task 2.2 Assess surface water harvesting, MAR and shallow GW potential

The Consultant shall propose a methodology for a remote sensing-based mapping component to identify favourable areas for water harvesting and MAR and likely areas with shallow groundwater potential. The proposed methodology should specify (i) the available information to be used (geological and other maps, reports, meteorological, hydro(geo)logical data, data on wells, water quality, demography, etc), (ii) the remote sensing layers to be used, that may include but are not limited to raster data sets on rainfall, evapotranspiration, soil moisture, surface water availability, NDVI, including the proposed time periods for variability analysis and (iii) the proposed analysis of used data sets including GIS overlay to identify water harvesting potential, areas with groundwater potential and other relevant spatial information related to groundwater potential (recharge) and groundwater demand, such as population (both human and livestock ) and potential areas for economic development.

The proposed methodology should consider climatic and hydrological variability in the assessment of water harvesting and shallow groundwater potential and its resilience to prevailing and projected drought conditions. The methodology should specify resolution of the

data sets used and proposed type and scale of maps to be produced. This task will be implemented in consultation with the IGAD-Groundwater Centre and ICPAC.

### Task 2.3 Compile data on aquifer geometry, characteristics, quality and uses

From collected reports, maps, data sets and field observations the Consultant shall compile in a Geographical Information System (GIS) all available data from wells (depth, aquifers tapped, yield, permeability/transmissivity, static and dynamic water levels, groundwater quality parameters, daily/annual abstraction rates, …) and prepare, in combination with other data sets, maps of aquifer geometry, aquifer hydraulic characteristics, groundwater quality aspects, groundwater abstractions.

### Task 2.4 Establish aquifer piezometry & dynamics

From collected reports, data sets and field observations the Consultant shall compile and analyse all available data on static and dynamic groundwater levels to:

- Elaborate a reference piezometric map that reflects all available knowledge on the current status of the aquifer. The method and data used to establish the piezometric map should be carefully selected;
- Evaluate seasonal and inter-annual dynamics of the aquifer and identify likely recharge areas;
- Screen available data for signs of local or regional groundwater trends, with special attention for indications of (local) over-use or depletion of groundwater and potential climate change impacts.

### Task 2.5 Build a dynamic groundwater model for the Dawa aquifer

The main objective of the groundwater model is to validate and test hypotheses on recharge dynamics and the available renewable aquifer potential, to support the feasibility assessment of proposed sustainable groundwater interventions under Task 3. This task includes:

- Construction of the 3D aquifer geometry, and preparation of maps of hydraulic properties, reference groundwater levels, recharge and discharge zones, etc;
- Defining of boundary on all the model boundaries, based on the conceptual model defined under Task 1, ensuring not to impose recharge or discharge flows;
- Calibration of the mathematical groundwater model in steady and transient state, to evaluate most likely recharge and discharge flows.
- Simulation of the aquifer evolution until 2050 under different water use and climate scenarios (with a maximum of 6), predicted by IPCC or ICPAC, to assess likely responses of the aquifer to increased use and impacts of climate change.

The uncertainties inherent to the different steps of model elaboration (conceptualization, boundary conditions, hydraulic conductivities, hydraulic heads, recharge, recharge zones) shall be quantified, in order to ensure that proposed groundwater development activities do not exceed the capacity of the transboundary aquifer. The Consultant will use a modelling software using the finite difference method and compatible with MODFLOW.

### Task 2.6 Evaluate safe available groundwater resource and identify water security threats

Based on the prepared groundwater model, its calibration and simulated scenarios the Consultant will quantify the renewable groundwater potential and identify the most promising areas for future groundwater development. The Consultant shall also identify the main uncertainties with respect to the resource evaluation and key information needs to reduce these uncertainties.

The assessment will consider and discuss possible long-term on the available groundwater resource due to climate change. The Consider will also evaluate uncertainties due to unavailability of information and identify priorities for additional data collection. The Consultant shall identify the most vulnerable areas with respect to water security, in particular during droughts and floods.

Under this task the Consultant shall also carry out an assessment of existing and potential management issues related to shared waters among any of the riparian countries, identify potential win-win situations as well as possible conflicts in the project area.

### Task 2.7 Identify potential groundwater development and drought resilience projects

Based on the expected available groundwater resource potential, its distribution, identified vulnerable areas and potential conflicts the Consultant shall identify, in consultation with the KSFG, priority areas within the 3 riparian countries for groundwater interventions, considering projected water needs for population, livestock and economic development, with particular attention to the needs of vulnerable groups.

The Consultant shall present an overview of suitable groundwater interventions aimed at increasing water security and climate resilience of the populations in the 3 riparian countries. The proposed interventions will incorporate the broad experience from the HoA and similar regions in the planning, design, construction and operation of water access, harvesting and buffering infrastructure in similar geomorphological and climatic conditions.

In consultation with the KSFG the Consultant shall then prepare a list of specific groundwater investment proposals for the 3 the riparian countries (maximum 5 per country) for water supply, support of livelihoods, strengthening climate resilience or economic development that will be considered for Feasibility Studies under Task 3 of this study. Proposed projects may include drilling of new or rehabilitation of existing boreholes, water harvesting infrastructure or interventions aimed at strengthening the resilience to drought of available water resources or improving aquifer sustainability.

Two types of groundwater development projects will be identified (i) shared (cross border) groundwater development and (ii) groundwater development within the riparian states with shared management to control and manage impacts. The proposed development plans shall describe the location, the size and main components of the project, the number and type of physical infrastructures (boreholes, wells, sand dams, gullies, tanks, etc.), expected number of people to benefit, estimate of investment and O&M costs and expected community participation in construction and O&M[12]. , and

### Task 2.7 Preliminary screening of investment proposals

The consultant shall conduct a preliminary technical feasibility screening of the proposed interventions, including for availability and reliability of the water resource and potential cross boundary impacts, based on the aquifer characteristics, type of interventions and distance to the border. The Consultant shall undertake environmental and social screening of identified potential groundwater development and drought resilience projects, including risk classification according to the World Bank and country specific standards. The screening shall be done for both cross border and country specific development projects.

Based on results of the preliminary technical feasibility and E&S screening the Consultant shall recommend 3 priority interventions to be considered for feasibility studies under Task 3. Considering the nature and scale of proposed interventions, the Consultant will prepare, with support from the KSFG, an inventory of local stakeholders for the proposed interventions and

[12] Based also on reported experiences from IGAD Member States

propose, in line with the provisions of the GW4R Project SEPs in the riparian countries, a plan for stakeholder consultations in each of the riparian countries.

### Task 2.8 Submit Interim report

The Interim Report shall present all the findings of the tasks completed under Task 2, including (i) the availability and variability of surface water resources and potential for water harvesting and MAR, (ii) the geometry, characteristics and piezometry of the Dawa aquifer, (iii) the mathematical groundwater model, calibration and modelled scenarios (iv) an assessment of available groundwater resources and water security issues, (v) an overview of the proposed investment opportunities to be considered for Feasibility Studies under Task 3 of the Project (vi) preliminary feasibility and E&S screening and proposal for 3 interventions in each riparian country, and (vii) an engagement plan and agenda for local stakeholder consultations, to be organized as part of Task 3.

Upon finalization of the draft Interim Report, a physical validation workshop will be organized in order to present and discuss with the KSFG and IGAD:

- the key findings of the surface and groundwater potential assessment, and;
- a presentation of the 5 identified groundwater development and drought resilience projects per riparian country;
- results of the preliminary screening and proposed list of 3 groundwaterinterventions for Feasibility Studies under Task 3;
- details of the proposed stakeholder consultation plans, in line with the provisions of the GW4R Project SEPs in the riparian countries.

Before finalization the final Desk Study Report will incorporate the consolidated comments and feedback from the validation workshop and IGAD, including a finalized list of 3proposed groundwater interventions per riparian country to be further developed and evaluated under Task 3.

## TASK 3: FEASIBILITY STUDIES FOR GROUNDWATER DEVELOPMENT AND IMPROVED DROUGHT RESILIENCE

### Task 3.1 Organize local stakeholder consultations

Based on the stakeholder consultation plans the Consultant will organize physical stakeholder meetings in the 3 riparian countries. The objective of the stakeholder consultations is to present and discuss with representatives of local authorities, communities and water users, the proposed groundwater interventions to identify their concerns and expectations on the proposed interventions, validate local demand, assess local capacity and other constraints impacting design, identify gender issues, discuss operation and management arrangements and evaluate environmental and social safeguards issues or possible water use conflicts. Particular interest will be paid to the representation of women in stakeholder discussions.

### Task 3.2 Evaluate Feasibility of proposed interventions

Under this Task the Consultant shall conduct field checks and elaborate preliminary design and costing for the 3 proposed groundwater and drought resilience projects per riparian country, in order to evaluate technical feasibility and identify potential environmental & social impacts. For each of the proposed investment projects the available surface water flows and/or groundwater potential will be evaluated at the field level, considering available data and

analyses, reports, groundwater model and field observations. This analysis will include an assessment of inter-annual hydro(geo)logical variability and expected CC impacts to evaluate expected efficiency and sustainability of proposed groundwater or water harvesting infrastructure and a preliminary cost-benefit analysis.

For each of the proposed infrastructures the Consultant shall conduct a preliminary assessment of potential environmental and social risks and impacts of proposed interventions categorized into (i) environmental risks, (ii) occupational health and safety risks, (iii) community health and safety risks, and (iv) social risks. Emphasis should be given to cross border and aquifer-wide risks. The risks shall be further segregated to indicate the different stages of the projects, i.e., pre-implementation, implementation, and operation phases.

Based on the feedback from local stakeholder consultations, the feasibility assessment and the preliminary assessment of environmental and social risks and impacts a final list of priority groundwater and drought resilience investment projects (1 per country) will be prepared, in consultation with the KSFG and IGAD.

### Task 3.3 Prepare Technical Designs & Implementation plans

The Consultant will prepare the preliminary technical design for each of the priority projects for water supply, economic development or strengthening drought resilience. This will include a preliminary engineering design (production wells, pipelines, treatment works, pumping stations, type, number and location of the water buffering/MAR interventions etc), with engineering drawings, technical specifications, bill of quantities and cost estimates.

The projects should also include implementation plans (with duration, skills and equipment needed, safety and ES impact management plan) in which contractors work with the community during the construction phase and ensure ownership after completion and handing over, as well as an O&M plan for 5 years, including a technical and financial management plan with stakeholder involvement. The implementation plan will pay particular attention to the representation of women in all aspects of the Project.

The Consultant shall recommend E&S assessment instruments to develop in accordance with project E&S instruments (ESMF, SEP, RF) and any other regional requirements, indicate the stages for development of the recommended E&S instruments and recommend E&S scoping for the main instruments to be developed. The Consultant shall also recommend measures to manage the identified impacts, including at transboundary level, based on the mitigation hierarchy, develop preliminary environmental and social management and monitoring plans that include impacts identified, recommended mitigation measures, responsibility for implementation, responsibility for monitoring, monitoring indicators, monitoring frequency, and management/monitoring cost estimates. The Consultant shall further assess capacity development needs for environmental and social management of the proposed interventions in the riparian countries and recommend downstream E&S assessment requirements for the priority projects.

The preliminary technical design and implementation plans will be presented and discussed with the KSFG, IGAD before finalization.

### Task 3.4 Prepare a groundwater monitoring plan

Under this task the Consultant shall prepare, in consultation with the 3 riparian countries, a groundwater monitoring plan for the Dawa aquifer. The groundwater monitoring plan is aimed at increasing the sustainability of the aquifer system by defining critical groundwater quality and quantity monitoring needs. The Consultant will design, in consultation with the KSFG and national departments of the riparian countries, a core network for groundwater monitoring of

the Dawa aquifer system, that will rely as much as possible on existing wells and infrastructure and will evaluate also opportunities for community or stakeholder involvement.

The design of the network shall be based on an analysis of key information gaps for confirming the aquifer potential and its dynamics and shall consider areas that are or may become under threat of groundwater depletion. This task also includes monitoring infrastructure and equipment specifications and the elaboration of monitoring, data processing and storage protocols.

### Task 3.5 Submit Feasibility report

The Feasibility Report shall present all the findings of the tasks completed under Task 3, including (i) evaluation reports of all priority groundwater interventions, including stakeholder feedback and field checks, (ii) Detailed Designs and implementation plans for the final list of priority interventions, and (iii) the groundwater monitoring plan.

Upon finalization of the draft Feasibility Report, a physical validation workshop will be organized in order to present and discuss with the KSFG and IGAD:

- The technical designs and implementation plans for 3 priority projects (1 per riparian country);
- Proposed groundwater monitoring networks and arrangements.

Before finalization of the Feasibility Report, the Consultant will incorporate the consolidated comments and feedback from the validation workshop and IGAD, including the final designs and plans for the proposed groundwater interventions.

## TASK 4 AQUIFER MANAGEMENT PLAN & DECISION SUPPORT SYSTEM

### Task 4.1 Develop an aquifer management plan

The Consultant will develop, in consultation with the KSFG and IGAD, an Aquifer Management Plan (AMP) to ensure the sustainable management of the groundwater resources of the Dawa aquifer. The AMP will propose technical, institutional and legal arrangements for the joint development and management of the Dawa aquifer by the riparian countries and will pay particular attention to the needs of nomadic and vulnerable groups. The AMP will include environmental and social requirements and procedures, including procedures for environmental and social appraisal of future interventions in the aquifer, and management and monitoring of the same.

The Aquifer Management Plan will also include proposed transboundary collaboration mechanisms, data sharing protocols and monitoring arrangements, based on the groundwater monitoring plan developed under Task 3. The AMP will pay particular interest to aquifer monitoring and management needs and collaborative crisis management actions during droughts.

### Task 4.2 Develop a Decision Support System

The Consultant will develop, in consultation with the riparian countries and IGAD, a Decision Support System (DSS) to ensure that new groundwater developments in any of the riparian states can be planned within the limits of the available water resources.

The DSS will be based on the predictive groundwater model scenarios prepared under Task 2 of this Project that will be regularly updated with groundwater monitoring and abstraction data. Based on the status of the aquifer and evaluated available renewable groundwater resources the DSS will provide guidance to future groundwater development plans.

The Consultant will also elaborate operational arrangements and collaboration needs for the operation of the DSS, including protocols to update groundwater model data with monitoring and abstraction data collected by the riparian countries as part of the AMP and recommend environmental and social criteria for future interventions.

### Task 4.3 Submit Final Report

The draft Final Report shall present all the findings of the tasks completed under Task 4 and include the key findings of Tasks 1, 2, 3, including (i) a description of the Dawa aquifer system (boundaries, hydrogeology, piezometry, quality, current uses, groundwater potential, …), (ii) availability and variability of surface water resources and potential for water harvesting and MAR, (iii) a presentation of the elaborated FSs for groundwater development opportunities.

Upon finalization of the draft Final Report, a physical validation workshop will be organized in order to present and discuss with the KSFG and IGAD:

- the DAWA Aquifer Management Plan and its implementation arrangements, and;
- the DAWA Aquifer Decision Support System and its operational arrangements.

Before finalization of the Final Report, the Consultant will incorporate the consolidated comments and feedback from the validation workshop and IGAD. The full scope of work of the Project is summarized in Figure 3 below.

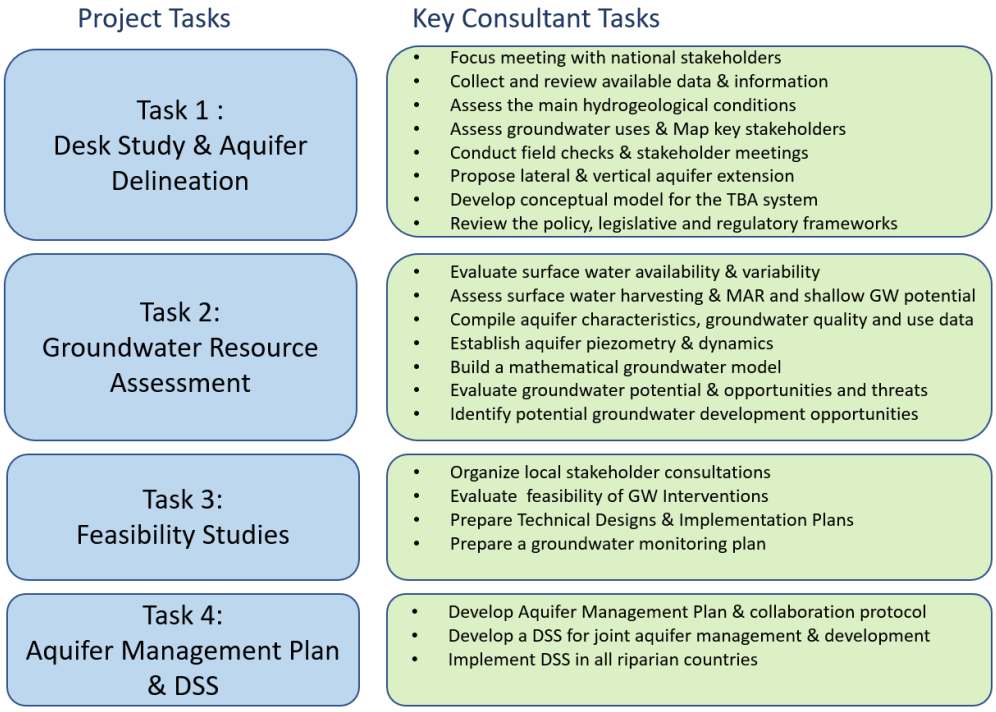


*Figure3: Summary of Scope of Work*

## 6. Project and Reporting schedule

The duration of the assignment will be twelve (12) months from contract signature. The Consultant shall submit deliverables in English language using common standard (MS Word, Excel, PowerPoint, …) and open source (QGIS, …) software, as per the schedule outlined below:

| Report | Description | End of month |
|---|---|---|
| Inception Report | Contains the updated work plan, state of mobilization, refined work methodology, issues identified for Client's attention, proposed content and structure of the various reports. | 1 |
| Desk Study Report | Contains the results of Task 1 (see Task 1.9 for more details).<br>The report will be submitted two weeks before the 1st stakeholder workshop and will be discussed during workshop. | 3 |
| Interim Report | Contains the results of Task 2 (see Task 2.8 for more details).<br>The report will be submitted two weeks before the 2nd stakeholder workshop and will be discussed during workshop. | 6 |
| Feasibility Report | Contains the results of Task 3 (see Task 3.5 for more details).<br>The report will be submitted two weeks before the 3rd stakeholder workshop and will be discussed during the workshop | 10 |
| Final Report | Contains the results of Task 4 and key findings from Tasks 1, 2 and 3 (see Task 4.3 for more details).<br>The report will be submitted two weeks before the validation workshop and the final report will be validated during the event. | 12 |
| Monthly Progress reports | 1-2 page maximum comprising a narrative and charts showing details of the Consultant's progress, changes in the assignment schedule, impediments and proposed remedies. | Every month |

# 7. Consultant staff qualifications

- The Consulting firm must have extensive proven experience of similar works with proven record of scope, complexity, and value. General groundwater monitoring work completed by the consultant in the past 10 years must be documented.
- The consulting firm must have completed in the past ten (10) years as a Lead Consultant at least two (2) similar works of groundwater assessment, groundwater monitoring programme design and annual groundwater monitoring report preparation.
- Previous or current assignments on projects of similar background in IGAD region and/or other countries with similar characteristics for the past 10 years as Lead consultant should be documented. Copies of References for the listed works should be attached. Consulting firm may associate with other firms in the form of a joint venture or a sub-consultancy to enhance their qualifications and certified copies of references must be attached.
- Working with donors funded projects (World bank, AfDB, GIZ. etc ) will be added advantage.
- The Consulting firm shall complement the list below to include additional local staff necessary for the implementation of the project.

| Position | Key competencies |
|---|---|
| **Team Leader / Groundwater Management Specialist** | Post graduate qualification in Water Management, Hydrogeology or Natural Resource Management with at least 15 years of experience in water resources management. The specialist should have proven experience in managing groundwater studies and working experience in the Horn of Africa. Being familiar with World Bank procedures is a plus. |
| **Hydrogeologist** | Post graduate qualification in Hydrogeology with at least 10 years of experience in hydrogeological exploration and groundwater studies in arid and semi-arid regions and working experience in the Horn of Africa. |
| **Water Supply Engineer/ Design and Cost engineer** | Post graduate qualification in water resources Engineering with at least 10 years of experience in water supply design, BOQs and Costs with groundwater as the source of water. |
| **Social/ Institutional Expert** | Post graduate qualification in Social Sciences (Anthropology, Sociology, …) with at least 10 years of experience in water supply or water management projects, with working experience in the Horn of Africa. Proven track record on stakeholder engagement and gender issues. |
| **Hydrologist** | Post graduate qualification in Hydrology or Water Resources Studies with at least 5 years of experience in hydrological studies in arid and semi-arid regions, with proven experience on water resources infrastructure development projects and assessing hydrological data under climate change scenarios. |

| | |
|---|---|
| **GIS / Remote Sensing expert** | Post graduate qualification in GIS/Remote Sensing with at least 5 years of experience in the application of GIS/Remote Sensing in water resources assessment or groundwater studies, with proven experience on the use of global / remotely sensed data sets in water resources studies. |
| **Environmental Specialist** | Post graduate qualification in Environmental science or Natural resources management with at least 5 years of experience in environmental studies specifically on groundwater abstraction with focus on groundwater development projects. |

## 8. Data and services to be provided by IGAD.

Data and documentation on groundwater studies which the riparian countries will be made available to the consultant. However, the consultant has the ultimate responsibility for collecting required data and documentation.

The Client will further (i) Facilitate in establishing communication with the relevant institutions, (ii) Liaise and assist the Consultant in obtaining any other information and documents required from other government agencies in the Member States and which the Client considers essential in conducting the assignment, (iii) Provide assistance to obtain entry to Member States for staff of the Consultant, (iv) Provide assistance in obtaining Tax Exemptions as detailed in Special Conditions of the Consultancy Agreement and (v) Arrange consultative meetings and ensure linkage with relevant regional authorities.

## 9. Implementation arrangements

The Consultant shall operate their own project office and shall bear all accommodation, local transportation, visas, and other costs necessary to carry out the assignment. He is invited to give details on the envisaged logistical set-up for the execution of the services in his technical proposal including for the fieldwork and site visits.

## 10. Payments Schedule

| # | Description | Amount US$ |
|---|---|---|
| 1 | Inception Report | 10% upon submission of acceptable Inception report. |
| 2 | Desk Study Report | 20% upon submission acceptable desk Study report. |
| 3 | Interim Report | 20% upon submission acceptable report. |
| 4 | Feasibility Studies Report | 30% upon submission acceptable Feasibility Studies report. |
| 5 | Final Report | 20% upon submission acceptable Final report. |

# Appendix 1 - Preliminary List of Reports

1. WATER COOPERATION IN THE HORN OF AFRICA: Addressing Drivers of Conflict and Strengthening Resilience , Stockholm International Peace Institut, December 2021

2. Identification of hydrogeochemical processes in groundwater of Dawa River basin, southern Ethiopia, Woldemariyam, F., Ayenew, T, Environ Monit Assess 188, 481 (2016). https://doi.org/10.1007/s10661-016-5480-3

3. Transboundary aquifer mapping and management in Africa: a harmonised approach, Yvan Altchenko, Karen Villholth, Hydrogeology Journal, Springer Verlag, 2013, 21 (7), pp.1497-1517. ff10.1007/s10040-013-1002-3ff. ffhal-02328461f

4. Nebiyou Kassahun, Mebruk Mohamed (2018), *Groundwater Potential Assessment and Characterization of Genale-Dawa River Basin.* Open Journal of Modern Hydrology, 2018, 8, 126-144