Terms of Reference for the hydrogeological modelling study to understand current and future groundwater availability in Djibouti under climate-change scenarios

Title: Expert in hydrogeological modelling
Organisation: Government of Djibouti
Projects: "Implementing NAPA priority interventions to build resilience in the most vulnerable coastal zones in Djibouti" and "Implementing adaptation technologies in fragile ecosystems of Djibouti's central plains"
Type of Contract: Full-time for 5 months
Deadline for application: 27 September 2015
Starting date: 15 October 2015

1. General Background of the Study / Assignment

Djibouti is vulnerable to climate change hazards particularly droughts and floods which adversely affect natural ecosystems, community livelihoods and infrastructure both in coastal and rural areas. The Least Developed Countries Fund (LDCF) is providing resources to the Government of Djibouti to implement two projects entitled "Implementing NAPA priority interventions to build resilience in the most vulnerable coastal zones in Djibouti" (LDCF 1) and "Implementing adaptation technologies in fragile ecosystems of Djibouti's central plains" (LDCF 2) respectively. These projects aims to reduce the vulnerability of ecosystems and local communities to the effects of climate change through: (i) constructing hard infrastructure to protect local communities against flooding and drought; (ii) restoring ecosystems to increase their resilience to climate-related hazards; (iii) promoting sustainable and climate-resilient livelihoods; and (iv) strengthening the capacity of Djibouti to undertake, monitor and plan appropriate interventions to buffer climate-related effects. LDCF 1 is focused on coastal areas particularly Khor Angar and Damerjog while LDCF 2 is implemented in the rural areas of Hanlé and Tadjourah.

Both projects are executed by the **Ministry of Habitat, Urbanism and Environment (MHUE)** in close partnership with the **Ministry of Agriculture, Water, Fish resources and Livestock, and other relevant ministries.** They are implemented by United Nations Environment Programme (UNEP) in cooperation with national stakeholders.

2. Assignment Requirements

This proposal is to build a hydrogeological model for the entire country of Djibouti to assess the combined impact of climate change and human activities on the availability and sustainability of groundwater resources (its current and future availability). The work will include: i) the development and calibration of a national scale three-dimensional groundwater flow model; and ii) assess the climate change impacts on groundwater system.

The overall objective is to provide sound scientific knowledge on the current and future availability of water resources in the light of anticipated climate change impacts to support: i) review of major national water management policies (the 'master plan for water'); ii) drought response mechanisms; iii) legislative and regulatory instruments governing the use of coastal resources; and iv) the design of field activities that increase the availability of water for local communities in the long term supporting sustainable water resources management.

Specific tasks for this study include:
1. Identification and collection of relevant data.

Nina Raasakka 9/21/15 5:13 PM
Comment [1]: I know Djibouti has very little surface water resources and mostly relies on groundwater – but would it be worth to integrate this into the TOR to get a comprehensive study?

Lucille Palazy 9/22/15 2:56 PM
Comment [2]: The study that Mohamed sent recently, produced by Global consulting for IGAD, focuses on surface water. The field for which more knowledge is urgent in on ground water distribution according to what I understood. Can you confirm Mohamed?

2. Undertake a statistical analysis to determine the contribution of regional and local climate events to the precipitation, evapotranspiration, streamflow and groundwater recharge in Djibouti.
3. Develop a mathematical model to predict seasonal and annual groundwater recharge for four out of the five regions of Djibouti (Ali Sabieh, Dikhil, Tadjourah and Obock).
4. Quantification of the recharge rate using climate data and geological spatial data.
5. Implement visual three-dimensional model to simulate groundwater flow under current and future climate change scenarios.
6. Characterize the intra and inter annual groundwater recharge dynamics under the current and predicted effects of climate change until 2100.
7. Assess the temporal changes in groundwater levels under current and future climate change scenarios under the current and predicted effects of climate change until 2100.
8. Study delivery, presentation and capacity building of national staff.

3. Study implementation

The details of the assignment tasks including completion time line is provided below. As part of his/her assignment, the lead consultant will train one or two national experts in Djibouti for a period of 10 days. Training will be provided on the basics of groundwater modeling, model setup, analysis of the findings, and their potential relevance to the policy. All the national data required by the lead consultant will be collected by a national consultant that will collaborate with him/her throughout the assignment period.

Total Time: 5 months maximum

4. Proposed break up and details of work to be performed under each task (changes to the methodology can be proposed by the lead consultant)

1. *Identification and collection of data (2 weeks)*
   The lead consultant will be responsible to obtain all publically available datasets (including spatial and non-spatial data) for conducting this study. A national consultant will provide him/her the locally collected and maintained data sets including all the available long-term records of meteorological, geological and climate data to the lead consultant. Required quality check and preprocessing of all the datasets used will be performed by the lead consultant.

2. *Undertake a statistical analysis to determine the contribution of regional and local climate events to the precipitation, evapotranspiration, streamflow and groundwater recharge in Djibouti (2 weeks)*
   This involves a broader understanding and analysis of precipitation, evapotranspiration and runoff data for Djibouti; review of literature; understand and analyze historical data on groundwater usage and availability. Establish relationships between various hydrologic parameters and groundwater recharge.

3. *Develop a mathematical model to predict seasonal and annual groundwater recharge for all the four districts in Djibouti (3 weeks)*
   This involves analysis of long-term records of precipitation, runoff, evapotranspiration and groundwater (well) datasets to develop a mathematical model to predict groundwater recharge rates in each of the four regions in Djibouti. In Dikhil and Tadjourah regions, a further objective is to assess the long term sustainability of the boreholes and other relevant water management infrastructures

built, rehabilitated and used under the LDCF project and other partner projects interventions and propose sustainable management strategies.

4. *Perform statistical downscaling of GCM and RCM driven climate parameters available from CMIP studies (3 weeks)*
This involves selection of CMIP GCM models for the future projection of the climate parameters. Analyze them in context of historical observations and future predictions. Building an appropriate downscaling model to downscale these parameters and make them suitable to be used in a three-dimensional climate model and successive modeling tasks at regional, national and local levels for Djibouti.

5. *Implement visual three-dimensional model to simulate groundwater flow under current and future climate change scenarios (3 weeks)*
This task the core task for this study. This involves setting up of three-dimensional visual three-dimensional groundwater flow simulation model; calibration of the model utilizing historical data; statistical downscaling of the GCM variables (precipitation and temperature); and groundwater simulation runs utilizing current and predicted climatic variables.

6. *Characterize the intra and inter annual groundwater recharge dynamics under the current and predicted effects of climate change until 2100 (2 weeks)*
This task involves analysis of the groundwater simulation results to quantify intra and inter annual changes in groundwater recharge under the current and projected climate change scenarios.

7. *Assess the temporal changes in groundwater levels under current and future climate change scenarios under the current and predicted effects of climate change until 2100 (1 week)*
This task involves analysis of the groundwater simulation results to understand the temporal dynamics of groundwater levels at each project site under the current and projected climate change scenarios.

8. *Study delivery, presentation, and capacity building (4 weeks)*
This task involves delivering a report, presenting the results and providing capacity building training to local experts in Djibouti. Capacity building training will be provided on the basics of groundwater modeling, three-dimensional model setup, analysis of the simulation results (groundwater recharge current and future scenarios), and use for the sustainable management of water resources. Similarly, he/she will hold a workshop to present the model build, its use, the results, their implication for water management and coastal planning and integration into relevant policy documents such as the Master Plan for Water to the members of the National Committee for Integrated Coastal Zone Management and relevant policy makers. These activities will be conducted by the lead consultant in Djibouti.

5. Deliverables

The lead expert will first provide a daily workplan including the detailed activities that he will conduct to the Project Manager (PM) and the Chief Technical Advisor (CTA). A monthly update of the progress and adequation with the initial workplan will be sent to the PM.

A report will be submitted to the project management team and relevant national stakeholders. This report will include *inter alia*: i) the description of the activities implemented by the lead consultant throughout his/her assignment; ii) the justification of the methodology used for data selection and processing, data

analysis, and model selection and development; iii) description of the models and protocols for future use and interpretation of the outcomes; iv) the interpretation of the results obtained; v) the implication of these results for on-going or future adaptation interventions particularly the construction of boreholes and other relevant water management infrastructures, and for national policy documents such as the Master Plan for Water; and vi) the description of the design, implementation and outcome of the training activities.

6. Qualifications and Experience

<u>The lead expert is expected to have:</u>
- an advanced post-graduate degree at or above MSc level in hydrology, hydrogeology, geotechnics or other relevant field;
- 6 years of experience in hydrogeological modelling in arid countries using multiple data sources including GCMs, RCMs, CMIP studies and local climate information;
- experience in running three-dimensional climate models and in using all relevant climate softwares;
- experience in designing plans and developing training material; and
- the ability to work independently and within a team to achieve project targets.

<u>Languages</u>
- Excellent written and spoken English.
- French will be a major advantage.

7. Submission Guidelines

The experts meeting the essential requirements of the position are invited to apply for this position before 28 September 2015 by submitting the following documents:
- letter of interest;
- technical and financial proposal; and
- Curriculum Vitae.

Electronic applications will be submitted to: housseinririach@yahoo.fr and med.djibril@yahoo.fr.

8. Additional Considerations

- Failure to comply with the above requirements will disqualify the application.
- Applications received after the closing date will not be considered.
- Only short-listed candidates will be notified or contacted.
- Qualified and experienced female candidates in particular are encouraged to apply.