NILE BASIN INITIATIVE
INITIATIVE DU BASSIN DU NIL

MOUNT ELGON TRANSBOUNDARY AQUIFER

Diagnostic Analysis and Groundwater Modelling: Results & Recommendations

This policy brief summaries the outcomes of Shared Aquifer Diagnostic Analysis (SADA) and Groundwater Modelling for the Mount Elgon Transboundary Aquifer. Both activities were conducted as a part of a groundwater project executed by the Nile Basin Initiative (NBI). SADA provides an overview of groundwater and its management in the Mount Elgon region, including related stakeholders, policy and institutional framework. The analysis identified knowledge- and management/governance gaps so that right steps required to tackle groundwater issues can be made. Development of the Mount Elgon groundwater model has improved a knowledge of the aquifer and provided insight into possible future of groundwater resources in the region. Conjunctive Water Management (CWM) is seen as an important part of sustainable use and protection of the Mount Elgon Transboundary Aquifer, and cooperation at all levels of governance as a necessary condition for achieving sustainability - for the benefit of all.

Introduction

Mount Elgon is an impressive former volcano situated in Eastern Africa, partly in Kenya and partly in Uganda. Raising more than 3000m from the surrounding plane, Mount Elgon is offering a cooling respite for many human settlements, and unique flora and fauna. Next to a favourable climate, the region is also fortunate with water resources, forming together a good base for general prosperity. However, human activities like pollution and over-abstraction are putting a pressure on water resources. Additionally, environmental changes such as rainfall amount- and/or pattern change, are often unfavourable for renewal of water storage, both at the surface and underground.

Mount Elgon is a home for a large groundwater storage, a Mount Elgon aquifer. Water from this aquifer has been used throughout the region to complement surface water, or instead of it, in places where surface water is polluted or not (always) present. Yet, a substantial part of population still does not have access to safe/clean water, while water demand is growing and pollution increasing. These facts ask for a significant improvement of water resources policy and management. Since the aquifer is shared between two countries, its good management also depends on international cooperation.

Nile Basin Initiative Groundwater Project

The Nile Basin Initiative (NBI) is carrying out a project entitled "Enhancing conjunctive management of surface and groundwater resources in transboundary aquifers: case study for selected shared groundwater bodies in the Nile Basin". The project aims to foster the more effective utilisation and protection of selected shared aquifers in the selected sub-basin in the Eastern Nile and the Nile Equatorial Lakes region through demonstrating conjunctive management that optimizes the joint use of surface and groundwater. One of three selected aquifers is the Mount Elgon Transboundary Aquifer. As a part of the project, so-called Shared Aquifer Diagnostic Analysis (SADA) is conducted, followed by development of a Groundwater Model.

Shared Aquifer Diagnostic Analysis

SADA is a comprehensive analysis of hydrogeological, environmental, socio-economical, policy and institutional aspects of shared groundwater resource, in this case the Mount Elgon Transboundary Aquifer. Firstly, data from Kenyan and Ugandan part of the aquifer were collected by specialists from various disciplines, to be subsequently compared and, where possible, unified.

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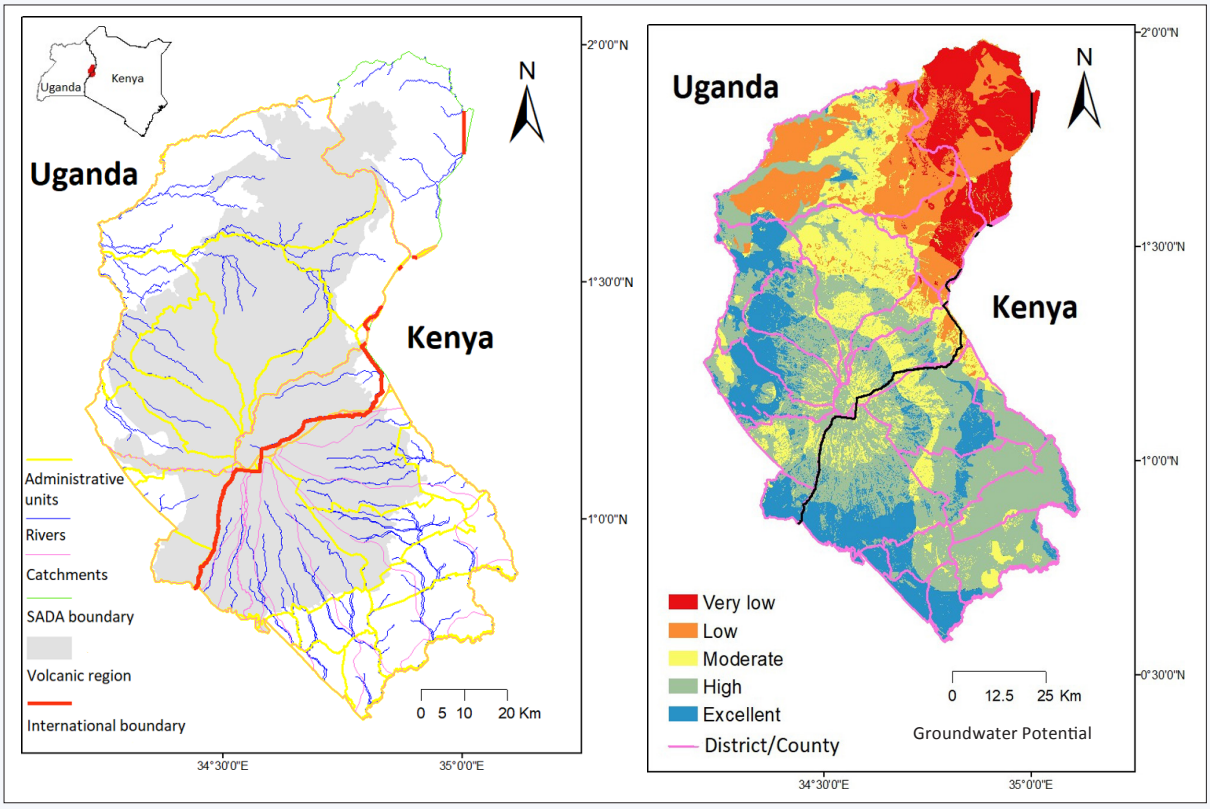
SADA shows that there is a fairly good understanding of regional hydrogeology and of the climatic and hydrological processes that influence recharge of the aquifer. However, too little is known about a state of the aquifer, primarily due to lack of groundwater monitoring. Although occasional measurements in production wells give some indication of the current state of groundwater, a dedicated groundwater monitoring network is necessary for adequate planning and managing of water resources. *Groundwater assessment is not complete- and no predictions can be made without analysis of historical data, consequently: we can't manage, what we don't see or measure!*

SADA provides a thorough overview of socio-economic situation in the Mount Elgon region. Undoubtedly, a rapid population growth is putting a high pressure on the environment, including the water resources. More people simply means more water needed for drinking, households, cattle and agriculture. With increased agriculture and urbanisation, a land cover is changing, effecting the aquifer recharge as well. Large scale deforestation (for construction and energy usage) is effecting not only recharge but also the soil stability and even the regional climate. Migrations to wetlands areas also often have adverse effect on water availability and quality.

Water quality is a matter of a major concern in the region, with pollution coming from multiple sources (agriculture, households, livestock, industry/mining, etc.). The prime pollution recipient are rivers, leading to increased abstraction of groundwater. Since surface- and groundwater are often hydraulically connected, some pollutants eventually reach the aquifer as well. Poor sanitation, including lack of latrines in rural- and sewage systems in urban areas, is a huge threat to water quality. Some shallow wells are already polluted but the baseline groundwater quality in the Mount Elgon aquifer is in general still good. Nevertheless, the urgent measures are required in order to mitigate further deterioration, also because the pollution load is rapidly increasing (will be doubled in 20-years' time).

Current groundwater policies and mandates are in detail presented in SADA, including equally detailed analysis of stakeholders at various level of governance. At the national level, both countries have the legislation in place that is needed for management and governance of water resources. However, much less is evident about directives and guidelines which are necessary to elaborate national policy for its implementation in practice at other/lower governance levels.



Necessity of groundwater monitoring: we can't manage, what we don't see or measure!

Water resources need to be managed conjunctively, hence in integrated and harmonized way.

Water management can be substantially improved only through better cooperation across scales, sectors/disciplines and administrative borders.

Neither Kenya nor Uganda have policies, laws, and institutions dedicated specifically to management of groundwater. Is groundwater 'visible' enough without being specifically addressed? At implementation level, groundwater is managed under Catchment based Water Resources Management framework in Uganda, and through the Basin Water Resource Committees in Kenia. Globally, it is often a case that groundwater does not receive sufficient attention in the river basin/ catchment management, nationally and internationally.

Conjunctive Water Management

Therefore SADA recommends that the water resources (including all the elements of water cycle) should to be managed conjunctively, hence in integrated and harmonized way. The benefits from the Conjunctive Water Management (CWM) are numerous:

* More water resources available for use and lower risk of water shortages
* Environmental benefits through the green infrastructure, landscape management and improving ecosystem services.
* Economic and social benefits (higher water and food security, less migrations, preventing conflicts, etc.).
* Improving planning and governance (avoiding double counting, easier identification of possible hazards and of opportunities).
* Improving synergy with international global policy priorities related to water such as Sustainable Development Goals (SDGs).

CWM is primarily a governance issue and depends heavily on institutional integration and cooperation, horizontally (among departments) and vertically (towards the implementation level). CWM can be improved (nationally and internationally) by inclusion of groundwater in the river basin policy documents, capacity building programmes for river basin authorities, implementation of groundwater monitoring and raising awareness.

Following the outcomes of SADA for the Mount Elgon Transboundary Aquifer, implementation of CWM is recommended in order to increase aquifer recharge. A Managing Aquifer Recharge (MAR) pilot is designed with a close involvement of stakeholders, enhancing their ownership and promoting regional cooperation. Selected MAR technique (induced infiltration) is a nature-based solution and the pilot location is chosen after a thorough environmental & social impact assessment.

Transboundary Water Cooperation

The main (additional to national) challenge while managing transboundary resources is sharing and harmonisation of data and information. According to SDG 6.5.2 Progress Report, a number of countries that cooperate on shared groundwater resources is steadily increasing. Kenya and Uganda have a proven record of international water-related cooperation, one of them being the NBI. The next effort of departments responsible for transboundary cooperation (Transboundary Water Resources Department in Kenya and International Transboundary Cooperation and Water Affairs in Uganda) would be therefore to establish a protocol for cooperation on Mount Elgon aquifer, including data sharing, according to United Nations recommendations. This will improve data accessibility and harmonisation and eventually managing of this precious resource. Internationally shared resources should be seen not only as a challenge but also as an opportunity for collaboration: joining the knowledge to learn more together for the benefit of all.

Groundwater Model

Collected data were further processed and together with SADA outcomes used to develop a numerical

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groundwater flow model. Groundwater model is an excellent tool for simulation of future state of an aquifer using scenarios. Yet, firstly the model needs to adequately simulate a current state of the aquifer, that is to be calibrated and validated. For these operations, historical groundwater observations are essential, unfortunately practically non-existent within the aquifer extent. Nevertheless, development of the Mount Elgon model has improved knowledge of the aquifer and provided insight into possible future of groundwater resources in the region.

In total six model scenarios were developed by increasing abstraction in current wells, adding new wells and/or including effects of climate change. All the scenarios predict decrease of groundwater availability in 2050, expressed in possible lowering of groundwater level of >10 meters, the largest in urban centres (up to 50m). Although not optimistic, these scenarios are still far from a possible worst-case, knowing that the abstraction used in the model is less than projected water demand in 2050. Moreover, the employed climate change projections show rainfall increase, in the model translated as a substantial increase of recharge, which is still quite uncertain.

Through further improvements (starting with inclusion of monitoring data), the Mount Elgon groundwater model can become a standard tool to support a management of water resources in the region, including conjunctive use and possible transboundary impact.

Data used for SADA and the model development were combined with additional (mostly geomorphological, hydrological and land use data) to developed a regional groundwater potential map. This map provides a first but important insight for policy makers and managers into possibilities for further groundwater- and conjunctive water development.

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