NILE BASIN INITIATIVE
INITIATIVE DU BASSIN DU NIL

KAGERA TRANSBOUNDARY AQUIFER

Diagnostic Analysis and Groundwater Modelling: Results & Recommendations

This brief document describes recommended policy and management measures for the Kagera Transboundary Aquifer. Recommendations are based on outcomes of a Shared Aquifer Diagnostic Analysis (SADA) and Groundwater Modelling, the activities carried out within a major groundwater project executed by the Nile Basin Initiative (NBI).

SADA provides an overview of groundwater characteristics of Kagera River Basin, pointing out a limited knowledge on current state of groundwater resources, mainly due to insufficient monitoring. Analysis confirmed that groundwater is underdeveloped, while the modelling indicated a groundwater potential to supply rapidly growing population of the Basin. To achieve that, concerted efforts of all stakeholders, from national governments to end users, are needed. Knowledge on groundwater and its importance can be strengthen through capacity building and awareness campaigns. Transboundary and conjunctive aspects of the current policy need to be updated and the management structure operationalised. Only in this way the access to clean and safe water can be preserved and improved.

Introduction

Kagera is a large river in Eastern Africa, flowing through Burundi, Rwanda, Tanzania and Uganda before discharging into Victoria Lake. Kagera River basin in endowed with a moderate climate, land for agriculture and sufficient water resources. Yet, this region is still generally one of high poverty, with substance farming as dominated livelihood activity. Rapid population growth, agriculture and poor sanitation are putting pressure on the Kagera river and its water quality. Therefore the water stored underground, in aquifers, deserves more attention.

In general, groundwater is of a better quality, less susceptible to pollution, and is available further from riverbanks. In the Kagera Basin, groundwater is currently used in rural areas for households and livestock, making up just a few percent of the total water consumption. Groundwater can be further developed to complement or substitute surface water, but firstly more should be known about characteristics of the aquifers in the Basin and possibilities for their exploitation. Diagnostic Analysis and Groundwater Modelling are important steps in that direction.

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 Kagera Transboundary Aquifer. As a part of the project, so-called Shared Aquifer Diagnostic Analysis (SADA) is conducted, followed by development of a Groundwater Model.

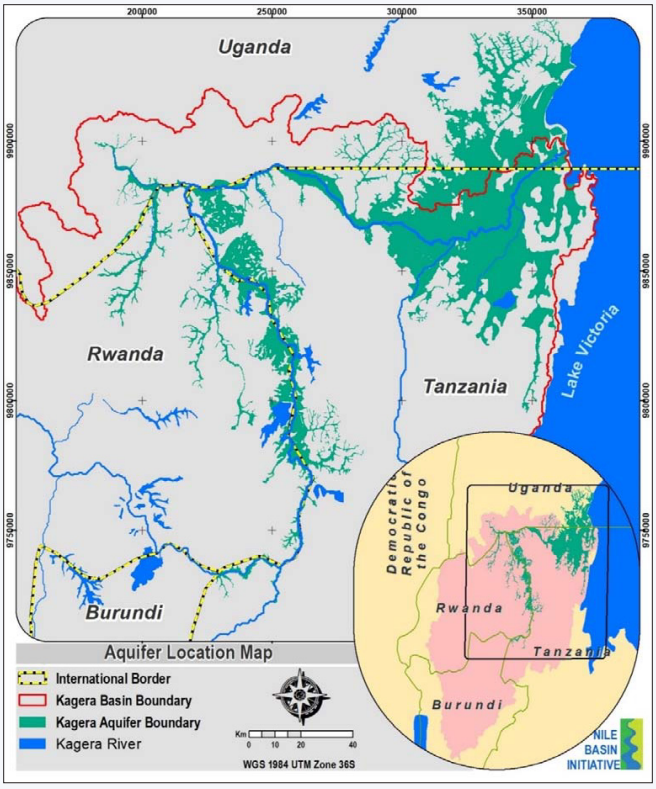
Shared Aquifer Diagnostic Analysis

SADA is a comprehensive analysis of hydrogeological, environmental, socio-economical, policy and institutional aspects of shared groundwater resource, in this case the Kagera Transboundary Aquifer. Data and information about these aspects were collected in four Kagera River Basin countries, to be subsequently analysed and synthetised into one joint report.

In the Kagera River Basin, the alluvial deposits along the river have the largest potential to store water underground. Sedimentary rocks and the basement which underlain the alluvium can also (especially when fractured) store and transmit groundwater but to a much lesser extent. Accordingly, only the aquifer developed in the Kagera River alluvial deposits is denoted as 'Kagera Transboundary Aquifer'. The Kagera Transboundary Aquifer consists of three segments, the lowland (delta) segment being the largest one, with the most storage potential. Three aquifer segments are strongly interconnected with the river and there is also a limited direct connection with the Lake Victoria in the delta segment.

Most of the environmental and socio-economic data used for the SADA refer to the whole Kagera River Basin, the area (ca. 59,800 km^2) almost ten times larger than the estimated aquifer extent (ca. 6,900km^2). Therefore the SADA outcomes in many aspects need to be seen as regional and orientational for any further, focused aquifer study. Currently, the data about the aquifer characteristics are very sparse and their estimates in SADA are mostly based on regional climate, geology, hydrology, geomorphology and general knowledge on groundwater in comparable basins. With absence of groundwater monitoring, even less is known about a state of the aquifer and its recharge and discharge. Although occasional monitoring in production wells can provide some indications, a dedicated groundwater monitoring network is necessary for adequate managing and planning 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!*

Similarly to environmental characteristics, the population data used in the analysis mostly refer to the whole basin, a home for more that 120M people. The population in the aquifer area is estimated to circa 0.9M and some local variations from the Basin's average could be expected. Nevertheless, it seems that that socio-economic characteristics in this aquifer area are very similar in all four aquifer-countries. The main economic activity is substance farming with crops and livestock. Small scale fish farming, manufacturing, agroforestry, brick making and trade are other common activities in the region.



Agriculture is mostly in hands of women, and collection of water is done by women and children. Access to improved safe water sources ranges within the area from 60% to 80%, and the average water use is about 25l/day per capita.

Authorities in the aquifer- countries are requesting development of groundwater resources as a part of dedicated effort to meet UN Sustainable Development Goals (SDGs) in 2030. Groundwater development can effectively enhance domestic water supply and also reduce the risks of waterborne diseases as groundwater is of better quality than surface water. The challenge however, is to prevent groundwater contamination from anthropogenic sources. High level of nitrate concentration has already been detected in a number of open shaft, originating most likely from fertilisers used in agriculture and from poor sanitation practice.

Although the prime pollution recipient is the Kagera River, because of its interconnectivity with groundwater some pollution is reaching the aquifer as well. Baseline groundwater quality in the Kagera Transboundary Aquifer seems still to be of good quality. Nevertheless, the urgent measures are required in order to mitigate further deterioration, also because of rapid increase of population and potentially polluting activities.

Current water policies and mandates are in detail presented in SADA, including analysis of stakeholders at various level of governance. The policies adopted by the countries follow the same principles of Integrated Water Resources Management (IWRM) with emphasis on participatory approach. The policies embrace the concept of catchment-based management, conservation of water sources, environmental impact, and of internationally shared water resources. Groundwater is often not separately addressed

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.

but considered as a part of water resources management. In general, the policy and related legislation is more centred towards the use and management of surface water. The four aquifer-countries address groundwater proportionally to prevalence of using it: Tanzania the most, followed by Uganda, Rwanda, Burundi (the least).

Several groundwater-related regulations and directives are developed at national level in the aquifer-countries, mostly to prescribe and guide well-drilling and protection of groundwater resources. In practice, however, enforcement of these regulations is rather weak, among others due to:

* Lack of funding for monitoring activities
* Shortage of trained enforcement officers
* Limited involvement of primary stakeholders due to lack of awareness and/or poor communication with stakeholders at the local level.
* Poor coordination between stakeholders at the national, regional, and local level

Evidently, effective communication across all levels of the governance and full involvement of stakeholders (especially at the implementation level) are necessary to ensure a proper groundwater management in practice. Communication and involvement lead to increased awareness and commitment and eventually a priority for funding (e.g. of monitoring of groundwater quality and quantity). Catchment-based water management is surface water oriented and groundwater often receives insufficient attention, nationally and internationally. National water authorities can increase focus on groundwater, assigning groundwater-related tasks through directives as well as daily management and reporting. Water user associations should be encouraged and assisted to better embed groundwater in their activities. After all, surface and groundwater in the Kagera region are hydraulically interconnected, meaning that one cannot be properly managed without the other.

Conjunctive Water Management

Therefore SADA underlines that water resources should be managed conjunctively, hence in integrated and harmonized way. The main benefits from the Conjunctive Water Management (CWM) are more water available for use and lower risk of water shortages.

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 Kagera aquifer, CWM implementation primarily means better inclusion of groundwater activities in the river water management, especially monitoring and data processing, capacity building and awareness raising. Additional groundwater explorations need to be planned and undertaken in order to increase access to clean safe water, which is a common ambition of all four aquifer countries. Only this joint and well-structured approach can ensure sustainable groundwater development (no dried wells) and protection (no pollution in wells).

Transboundary Water Cooperation

Transboundary cooperation on shared natural resources is needed to ensure their proper management and prevent potential conflicts. According to SDG 6.5.2 Progress Report, a number of countries that cooperate on shared groundwater resources is steadily increasing. Transboundary Aquifers (TBA) should therefore be seen not only as a challenge but also as an opportunity/platform for collaboration: joining the knowledge to learn more together for the benefit of all.

The water policies of the four Kagera TBA countries have in essence the same guiding principles and goals allows for the establishment of a legal framework for joint management of transboundary water resources. There might be some differences in water allocation customary law but very locally. The most important is that the countries join the forces in

better use and protection of water resources. A common coordination committee can be set up for both surface and groundwater in the Kagera Region but groundwater should be clearly represented in all activities.

The main (additional to national) challenge while managing transboundary resources is sharing and harmonisation of data and information. The first activity of the Kagera TBA Committee would be to establish a transboundary monitoring network. Indications of pollution or groundwater depletion should be used while choosing monitoring well locations. A simple protocol can be developed about sharing of collected data. The countries can decide to develop a common monitoring data repository for the aquifer, to facilitate a baseline assessment by their specialists. Any water-related planning and groundwater development should be based on this assessment and further, regular monitoring.

Groundwater Model

Due to shortage of data, outcomes of the current Kagera Groundwater Model should be considered as indicative, yet providing an insight into a possible change of groundwater resources in the region due to climate and human activities.

As an input in the model, current groundwater abstraction - based on population figures and consumption per capita - was estimated at circa 3Mm^3 per year. Then the model was used to estimate groundwater abstraction in 2050, taking in account the projected population growth and consumption increase per capita. According to the model outcomes, the maximal acceptable groundwater abstraction (circa 50M m^3/y) could satisfy about 70% of projected population water

needs in 2050. These figures, although just an indication, show a potential to supply rapidly growing population of the Kagera Basin.

Through further improvements (starting with inclusion of monitoring data), the Kagera Groundwater Model can become a standard tool to support a management of water resources in the region, certainly including climate change impact. According to global climatic predictions, the Kagera Basin will experience increase of precipitation. Nevertheless, water resources may still be negatively impacted due to predicted increase of temperature and potential increase of evapotranspiration (related to reduction of CO_2). Therefore, the climate change should always be, together with human impact, taken in account while planning and developing the Kagera Transboundary Aquifer.

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