

Community-based quality management of non-piped drinking water sources in Koboko and Yumbe

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ABSTRACT

Rapid population growth and negative impacts of human activities result in heightened risks to the safety of urban water supplies. The local councils of Koboko and Yumbe, in cooperation with the Reform of the Urban Water and Sanitation Sector Programme, recognised this risk and decided to establish a quality management system for non-piped drinking water sources. This approach is based on community participation, cost-efficient and reliable monitoring measures as well as on joint capacity development. In this paper, the functioning of the system will be presented in detail and experiences gained thus far will be illustrated.

Key words | capacity development, non-piped drinking water supply, quick test methods, risk management, stakeholder involvement, water quality monitoring

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INTRODUCTION

Koboko and Yumbe are fast growing district centres with estimated total populations of 53,000 and 28,000, respectively (Koboko Town Council 2011; Yumbe Town Council 2011). Both towns are situated in the West Nile Region in the northwest of Uganda. The coverage rates of centrally piped water systems in Koboko and Yumbe currently stand at 12% (APT 2012) and 32% (Kagulu 2012), respectively. Since May 2011, a Technical Advisor from the RUWASS (Reform of the Urban Water and Sanitation Sector Programme) programme, which is being implemented by GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH) on behalf of the Government of Germany, has been working with local authorities in order to contribute to a sustainable and safe water supply for the urban population.

While the piped water systems have been extended, hand pump boreholes and springs still play a significant role in the water supply of densely populated areas of the towns' informal settlements and other low-income areas. The rapid population growth results in a heightened risk to the urban water supply. Both water quality and quantity are increasingly endangered due to the negative impacts of human activities, such as encroachment, the destruction of wetlands and forests, and the pollution of soil, surface waters and groundwater recharge

areas. The many negative consequences of human activities are amplified further by extreme weather patterns such as heavy rainfall, flooding and droughts. Although the number of cholera outbreaks is decreasing, the local councils of Koboko and Yumbe recognised the growing risks of water contamination through human activities and decided to establish a quality management system for boreholes and springs, as these constitute the most vulnerable parts of the supply system. The success of such measures towards water safety is highly dependent on the capacities of those managing the sources and on the resources made available to them. The system requires regular support from the local authorities with regard to community training, periodic updating and water quality surveillance (WHO 2005). To ensure sustainability in the approach, the quality management system of Koboko and Yumbe Town Councils is based on community participation, the transparent assignment of responsibilities and information, cost-efficient and reliable monitoring measures and joint capacity development. Simple but reliable monitoring approaches and testing equipment enable the Town Councils to meet their responsibilities as a water authority without exceeding their financial and personnel capacity. The system has been developed jointly by the Town Councils

and GIZ and is tailored to the specific conditions of Koboko and Yumbe.

THE QUALITY MANAGEMENT SYSTEM

Main elements

The main elements of the water quality monitoring system are: system assessment, capacity development, stakeholder involvement and the actual monitoring. These elements are illustrated in Figure 1. Part of the system assessment is the development of a database including the mapping of water sources, a risk assessment and a comprehensive water quality analysis. The result of this assessment determines the approach to monitoring, which includes the actual monitoring of water quality, feedback collection and updating of the database. Capacity development of all stakeholders enables them to play their part in the management

system. The stakeholders are involved through establishing water user committees (WUCs), feedback mechanisms and monitoring measures.

Assessment results

The first step in implementing a quality monitoring system is the system assessment. A simple database has been developed and fed with all the necessary information about the non-piped water sources. This includes the mapping of locations, contact information and water quality test results. MS Excel was used to create this database so that it can be altered and updated easily by the staff of the Town Councils. Another element of the system assessment is a brief risk assessment. The most important non-piped water sources are deep boreholes (20–60 m) with hand pumps; shallow wells with hand pumps and protected springs (Koboko only) are also used for drinking water supply (Ministry of Water and Environment 2011). The major risk affecting

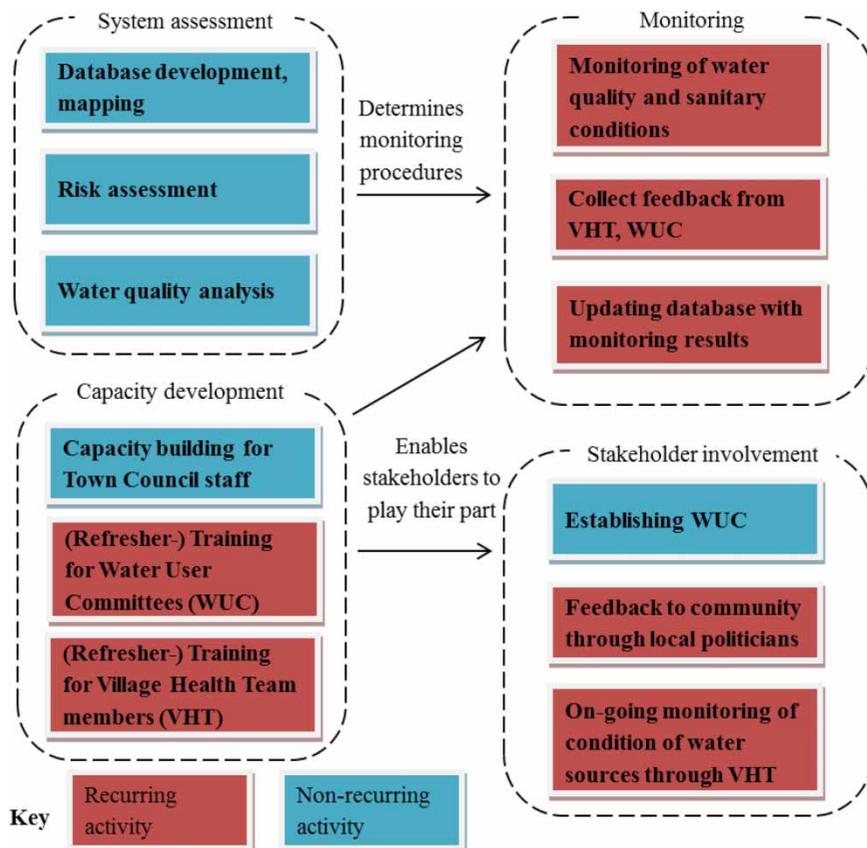


Figure 1 | Main elements and activities of the monitoring system.

the quality of these sources is contamination through human and animal faeces. Industries and other sources of (chemical) pollution, such as pesticides from intensive agricultural activities, are uncommon in both towns. To get information on the water quality and condition, a physico-chemical and biological analysis of 20 boreholes in each town has been conducted. The survey focused on those non-piped sources generally assumed to be safe for consumption. Thus unprotected sources were not tested at this stage. Table 1 shows the parameters of this analysis and comments on the results regarding national standards.

Violations of standards were observed in the cases of pH, turbidity, iron, manganese and faecal coliforms. The high iron and manganese concentration as well as the deviation in the pH value is likely the result of the geological formation and natural water quality conditions. According to WHO Guidelines on Drinking-water Quality (WHO 2011), neither manganese nor iron is of health concern at levels found in drinking water, and therefore no guideline value is proposed; the violation for pH might lead to corrosion in the hand pump pipes but has no significant impact on health since the deviation is small. The contamination with faecal coliforms is most probably directly

connected to human and animal faeces. This first analysis and the risk assessment are the basis for the parameters and procedures of the monitoring system that has been developed.

Stakeholder involvement

It is crucial for community-based water quality monitoring that the concerned stakeholders are involved from the beginning. In line with the recommendations of the Ugandan National Water Quality Management Strategy (Ministry of Water and Environment 2006), the following key stakeholders have been identified for the towns of Koboko and Yumbe:

- Town Council staff (in particular Town Water Officer, Town Health Inspector): They are responsible for the implementation of the monitoring system and are to conduct the training of the stakeholders.
- Village Health Team (VHT): The VHT members are part of the official health management structure and are volunteers who assist the community in their own part of town on various health-related issues.
- Water users: The water users are the community members who rely on the source.

Table 1 | Parameters for chemical analysis and comments on results

Parameter	Comments on results in Koboko	Comments on results in Yumbe	National standard for potable water (maximum permissible) ^a
pH	17 samples (85%) below national standards (max. deviation 5.65)	14 samples (70%) below national standards (max. deviation 5.65)	6.5–8.5
Turbidity	11 samples (55%) exceeding national standards	4 samples (20%) exceeding national standards	10 NTU
Total dissolved solids	All samples compliant	All samples compliant	1,500 mg/l
Hardness (CaCO₃)	All samples compliant	All samples compliant	500 mg/l
Chloride	All samples compliant	All samples compliant	500 mg/l
Fluoride	All samples compliant	All samples compliant	1.5 mg/l
Iron	10 samples (50%) slightly exceeding national standards	2 samples (10%) slightly exceeding national standards	1 mg/l
Sulphate	All samples compliant	All samples compliant	200 mg/l
Manganese	6 samples (30%) slightly exceeding national standards	All samples compliant	0.2 mg/l
Nitrate	All samples compliant	All samples compliant	5 mg/l
Nitrite	All samples compliant	All samples compliant	0.2 mg/l
Faecal coliforms	2 samples (10%) contaminated	All samples compliant	0

^aSource: National Water and Sewerage Corporation (NWSC) Central Laboratory, Kampala, Uganda.

- **WUC:** WUCs are established at most water sources and are elected by the water users. The management of the source is their responsibility.
- **Local politicians:** The local politicians are involved in giving feedback to the water users and the mobilisation of the communities.

The interaction between the key stakeholders is illustrated in [Figure 2](#).

Two elements of the monitoring system concern the stakeholders. The first is capacity development. Tailored capacity development measures and on-the-job training prepare the stakeholders to take up their active roles in the process and enable them to make significant contributions to the quality monitoring system. Thus, staffs of Town Councils, WUCs and VHTs receive training. The focus for the capacity building of the Town Council staff is on conducting water quality tests using a portable testing kit, thereby refreshing their knowledge on source protection. WUCs were trained on maintenance, source protection, bookkeeping (costs for operations and maintenance of the boreholes are to be met by the water users and every household is requested to contribute between 500 and 1,500 Ugandan Shillings (EUR 0.2–0.5) per month), the safe water chain, and water, sanitation and hygiene (WASH). Source

protection, the safe water chain and WASH were also the focus for training the VHTs. The WUCs and VHTs act as multipliers to inform and educate the community on WASH and the safe water chain. Therefore it is advisable to carry out regular (annual) refresher training. The training is facilitated by the staff of the Town Councils.

Monitoring procedure

Each water source has a WUC elected by the water users. In Koboko and Yumbe, the WUCs have already been established before implementation at almost all water sources to ensure the proper management and maintenance of the source. The feedback on water quality and other information from the Town Councils are channelled through local politicians. They receive information on the outcomes of the monitoring activities in their respective villages and inform the communities. If necessary, they organise community meetings where also the VHTs and Town Council staff members are involved. The local chairperson can also organise community work to improve the situation at the water sources. VHTs are involved regularly in monitoring the sources in their own villages. Since they are part of the community and are carrying out other health-related activities, the VHTs are asked to visit the water sources regularly, monitor

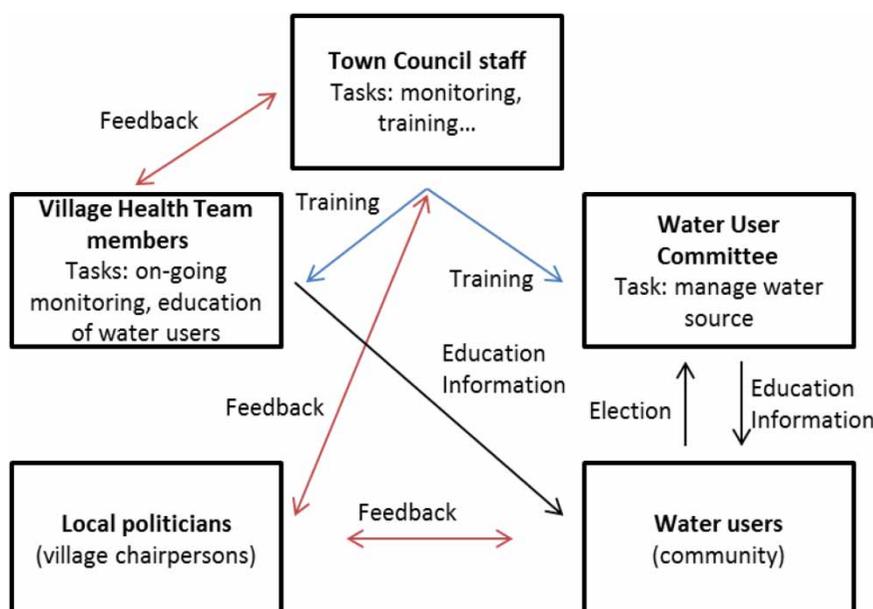


Figure 2 | Interactions between key stakeholders.

their sanitary condition and surroundings, and inform and educate the water users about the safe water chain and WASH.

The staff of the Town Councils, particularly the Town Water Officer and the Town Health Inspector, carry out regular water quality tests. After the first comprehensive water quality analysis and the risk assessment, it was decided to focus the testing on faecal contamination. This follows the WHO recommendations, that water safety measures at boreholes should focus on microbial quality and, in particular, on pathogens derived from faecal contamination, as such small systems show a high vulnerability to microbial contamination (WHO 2005). The indicator *Escherichia coli* was chosen as it is considered most suitable for testing for faecal contamination (WHO 2011). The routine tests are conducted with a portable testing kit using the membrane filtration method. Turbidity is also monitored using the simple turbidity tube method. Each non-piped drinking water source is tested bi-annually (rainy and dry seasons). In addition, a sanitary inspection of the surrounding environment is carried out while sampling. This inspection is based on a simple questionnaire that allows an assessment of the risk of contamination on a scale from 0 to 10 (0–3 low risk, 3–5 medium risk, 6–8 high risk, 8–10 very high risk). Part of the monitoring is also to collect feedback from VHTs and WUCs while in the field and at regular meetings. All information and findings are fed into the database, which is also updated should anything be reported between testing sessions.

DISCUSSION

The implementation of the management system started at the end of 2011. The experiences gained and challenges faced so far are discussed in the following paragraphs.

Looking at the monitoring of different kinds of non-piped water sources, it has been demonstrated that only deep boreholes can provide safe drinking water within town boundaries. Most of the protected springs and shallow wells and all unprotected sources have been found to be highly contaminated. Based on similar experiences, the Ugandan water sector recognises only deep boreholes to be part of the safe water supply in small towns (for the

transition period from non-piped to piped water systems) and no other non-piped sources. Users of contaminated water sources are repeatedly informed not to use the unsafe water for drinking and cooking. Actual enforcement (e.g. closing of an unsafe source) is challenging because of – inter alia – the political relevance of water supply and the lack of sufficient alternative sources in close proximity. Both Town Councils have been informed and are discussing ways forward, including by-laws and closing of sources.

In Koboko, the initial water quality analysis indicated that two boreholes were heavily contaminated with faecal matter. Immediate measures were taken. Community meetings were held, water users informed and, in cooperation with a locally active non-governmental organisation, water safe tablets for treatment at household level were distributed. One of the boreholes is located in a congested area with a number of pit latrines around, which have been suspected to be the source of its contamination. With financial support from the German Development Cooperation, the traditional pit latrines have been replaced with lined latrines that are under the management of the communities. The borehole has been flushed with chlorine. One year later the water quality had improved and showed no sign of faecal contamination.

The second borehole is located near a swamp, which might have been the source of the contamination. Piped water was extended to that area and a public stand pipe was installed. In both cases Koboko Town Council reacted immediately and mobilised available resources within the group of water and sanitation stakeholders (including non-governmental stakeholders). Having actual data on hand to prove the urgency of the matter helped the authority to mobilise stakeholders quickly. By bringing together local politicians, development partners and the communities, the Town Council was able to facilitate both emergency interventions and sustainable solutions in a short time. At the borehole near the swamp, communities now have access to an alternative (piped) source. Sensitisation measures were carried out to increase the use of piped water and to improve source protection by the communities.

For the introduced quality management of the non-piped water sources, it is important to get the concerned stakeholders involved in the activities. Motivation and interest, especially on the side of the Town Council staff, is crucial for the implementation of the system. This is also

the most challenging part of the implementation of the management system. The experiences in Koboko and Yumbe show that the Town Council staff have been generally committed, but needed reminders from time to time. For the other stakeholders, experiences vary. Some WUCs have been very active, fencing the borehole, keeping the surroundings clean and reminding users to clean their jerry cans; others do not put any effort into maintaining the water source they are supposed to be managing on behalf of the community. Similar observations can be made with regard to the VHTs and local politicians. Some put effort into voluntarily sensitising and informing communities, others ask for a monetary reward or transport support.

The quality monitoring system has also proved to be cost-efficient. The only major investment for the Town Councils was the procurement of a testing kit. However, most towns in Uganda already have access to such a kit through the District Water Office. In addition, the National Water and Sewerage Corporation has 17 satellite water testing laboratories, and basic laboratories are operated by, for example, non-governmental organisations and food processing industries (Ministry of Water and Environment 2006). The town authorities only need to budget for consumables (chemicals, filters, pads), transport and staff costs. As water quality monitoring has been reduced to two critical parameters, the water office of the Town Councils only needs to budget for the consumables of the bacteriological analysis. Costs for these chemicals may vary. However, bi-annual testing of all public boreholes in Koboko and Yumbe requires consumables worth less than 65 EUR (for 30 samples) per year per town. Depending on the available testing kit, a variety of other parameters can be tested, if necessary and the financial means are available.

The development of a simple database helps to provide all information in an easily accessible way. This also includes a schedule for each source which determines the date of the next water quality testing and sanitary inspection. All results are recorded, as well as the measures taken. Apart from protecting the water sources and monitoring the water quality, this monitoring system also addresses the need for sensitisation of the water users. It is important to educate the community especially on issues such as the safe water

chain (clean transport containers, clean storage containers) and WASH (personal hygiene, hand washing). This is to be achieved through the training of multipliers (VHTs, WUCs).

CONCLUSION

The introduced quality monitoring system is a simple and effective way to protect the drinking water supply of non-piped water sources. It makes use of the existing structures, such as the Health Departments and Water Offices of the Town Councils, VHTs and WUCs, and involves local politicians. No specific set of skills is required on the side of the implementers, other than the ability to apply a systematic approach of cooperation, public participation and awareness. The technical requirements correspond to the available resources of small towns in Uganda.

The community-based water quality management system has been implemented successfully in Koboko and Yumbe, and the approach can be recommended to other comparable small towns with a similar setup (no or a low degree of piped water coverage, safe ground water, no larger industries or other sources of pollution nearby) that still rely on non-piped water sources.

REFERENCES

- APT 2012 4th Quarter Report 2011/2012 of the Private Water Operator Koboko.
- Kagulu 2012 3rd Quarter Report 2011/2012 of the Private Water Operator Yumbe.
- Koboko Town Council 2011 5 Year Development Plan FY 2011/2012–2015/2016.
- Ministry of Water and Environment 2006 *National Water Quality Management Strategy*. Kampala, Uganda.
- Ministry of Water and Environment 2011 Water and Environment Sector Performance Report 2011, Kampala, Uganda.
- WHO 2005 *Water Safety Plans. Managing Drinking-water Quality from Catchment to Consumer*. World Health Organization, Geneva.
- WHO 2011 *Guidelines for Drinking-water Quality*, 4th edition. World Health Organization, Geneva.
- Yumbe Town Council 2011 5 Year Development Plan FY 2011/2012–2015/2016.