Geophysical Water Exploration and Self-Supply in Post-Conflict Uganda

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Summary

From 1986 until 2008, Joseph Kony lead the Lord's Resistance Army (LRA) in an insurgency in Northern Uganda, largely focused in the Acholi speaking sub-region known as Acholiland. Beginning in 1996, the Government of Uganda concentrated the approximately two million rural Acholi population into "protected villages." Meanwhile, the war against Kony, his approximately 3,000 rebels, and approximately 65,000 child soldiers was prosecuted. The "protected villages" were essentially concentration camps with the highest mortality rates in the world. In 2008, Acholi people began returning to their abandoned and destroyed villages. The reestablishment of safe and accessible village water supplies remains a regional need. At the same time, marginalized Acholi youth returning as child soldiers, human beasts of burden, internally displaced persons, or simply as young people lacking education were and remain in need of developing livelihoods.

This talk will describe the training of Acholi people to begin the redevelopment of their water supplies, and the technically focused water exploration and well rehabilitation programs that followed. The talk will describe short training programs in 2015 and 2016, and water supply development campaigns that were executed in 2018 and 2023. Water exploration was carried out in search of crystalline basement aquifers. Geoelectrical and terrain conductivity methods were used for surface exploration. Borehole terrain conductivity and magnetic susceptibility logging were used to guide and interpret the surface exploration program. An intensive aqueous geochemical sampling program was carried out that included major and trace metal ion analyses, stable isotope analyses, and a novel field E. coli bacteria analysis method. A simple but highly effective hand pump assessment method was introduced that is a significant improvement over evaluation criteria currently in use. To date, safe and accessible water has been made available to approximately 15,000 rural inhabitants in 30 villages, 2000 primary school students; and one major health clinic.

2018 where young Acholi were trained in all aspects of water supply including geophysical water exploration, manual drilling, and hand pump repair and installation. The talk will focus on the geophysical aspects, beginning with the introduction of 1-D resistivity in 2015; moving to modeling, interpretation, and the establishment of small, entrepreneurial water companies in 2016; and applications of 2-D resistivity and borehole geophysics in 2018.

In most humanitarian crisis situations, security, medical attention, shelter, food, and water are in acute need. Finding sources of potable water, usually targeting around 20 liters per person per day, can often be assisted with geophysical surveys. Where surface water sources are insufficient or not available, geophysical exploration programs for groundwater resources may be essential for satisfying water demands.

Typically, geophysical exploration programs will be focused on identifying high yielding, low salinity aquifers. However, even in crisis situations, other water quality parameters should be examined and assessed when planning and interpreting the geophysical exploration program.

This talk will discuss specific case studies where hydrochemical parameters had clear implications on the exploration and development of water supplies in emergency situations. After the 2004 Indian Ocean tsunami, groundwater resources along the Sumatran coast were evaluated not only based on salt water impact as mapped by geophysical airborne surveys, but also on the less predictable presence of elevated trace metal concentrations. In the Kakuma Refugee Camp in northwestern Kenya, geophysical surveys specifically targeted alluvial aquifers (Figure) whose geology would imply fluoride concentrations lower than the ubiquitously pumped weathered volcanic aquifers. In the severely overcrowded Rohingya refugee camps in southern Bangladesh, where annual rainfall exceeds 3.5 m, the delineation of aquitards and zones of groundwater protection is as important as delineating aquifers. In Northern Uganda, where the geophysical siting and drilling of community boreholes is usually done without an extended pumping test, general water quality parameters and isotope geochemistry can give at least a general sense of the source and frequency of groundwater recharge in shallow crystalline basement aquifers