Analysis of loading and transportation of anthropogenic pollution on shallow groundwater in peri-urban areas- Case of Bwaise III, Kampala

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Abstract

Groundwater is a key resource in much of the world. Many major cities and small towns in the world depend on groundwater for water supplies, mainly because of its abundance, stable quality and also because it is inexpensive to exploit. In developing countries, use of shallow groundwater sources for drinking and other domestic purposes is a common feature of many low-income communities. The communities relying on such sources tend to be poor and live in polluted environments with associated high health risks. Such communities occur in most cities in developing countries, for example in Asia, Africa, Latin America and the Carribean. Their occurrence is attributed to rapid urbanisation where urban growth is associated with rapid expansion of small, unplanned urban centres and peri-urban settlements. Sub-Saharan Africa hosts the largest proportion of the urban population residing in informal settlements (72%). These settlements often contain the majority of the city's population, for example more than 60% in Kampala. Such settlements are mainly characterized, among other things, by high population densities, deplorable housing, inadequate basic service infrastructure (safe water supply, sanitation, roads etc), location in flood plains and lack of legal status as residential dwellings. It is estimated that about 80% or more of the low-income peri-urban population in the developing countries is currently using groundwater for drinking water purposes. Urban groundwater quality in these peri-urban informal settlements is therefore an issue of increasing concern due to the high rates of contaminant generation per unit area and limited waste management systems.

In Kampala's peri-urban areas, the environmental sanitation is largely poor. Despite the existence of piped water supply infrastructure within the city, the use of shallow groundwater sources in the form of protected springs is common in these settlements. Recent studies carried out in these areas suggest a link between the incidence of cholera, acute diarrhoea and use of contaminated protected springs. In addition, due to poor sanitation, disease outbreaks (malaria, cholera, typhoid, etc) are prevalent especially during rainy seasons as a result of flooding. Therefore, contamination of the springs clearly poses a direct and immediate public health risk to these communities. Currently there are limited data and analysis of available information. Moreover, there is no basis for assessing the impact of the resultant loads on the subsurface waters in these areas. Efforts to mitigate the impacts of this pollution are limited by, amongst other reasons: lack of a comprehensive database on pollution from domestic sources, financial constraints, land-ownership issues, and non-implementation of mitigation measures by local communities. This study therefore aims at creating a better understanding of the quantities and impact of anthropogenic pollution and transport in a typical peri-urban settlement in Kampala (Bwaise III) on shallow groundwater. Here, pollution characteristics (sources, locations, types and loads), hydrogeological and soil attenuation potential characteristics in the area were investigated. In addition, different stakeholders were consulted (community residents, policy makers, utility (water) providers and municipal authority) in the identification of mitigation measures for such areas. The generated information from field and laboratory measurements is being used to build a numerical model that can be utilized as a supportive tool in assessing the vulnerability of and management of shallow aquifers in peri-urban settlements in Kampala and elsewhere with similar hydrogeological settings.

The findings of this study can guide implementation of measures aimed at preventing contamination of shallow groundwater sources and improving the environmental sanitation in the peri-urban settlements. By doing this, contribute towards Pillar 5 of PEAP Human Development which includes rural and urban water supply and sanitation. In addition, contribution towards Goal 7 of the UN Millennium Development Goals (MDGs) that seeks to ensure environmental sustainability with the specific target 10 "reduce by half the proportion of people without sustainable access to safe drinking water and basic sanitation" is made. These contributions if realised, further play a role in the reduction of child mortality, maternal health, major infectious diseases, and quality of life of slum populations, targets 5, 6, 8, and 11 respectively of Goal 7 of the MDGs. Improved water supply and sanitation also contributes to Pillar 2 of PEAP that is, enhances production, competitiveness and incomes (including water for production and water resources management) and is linked to academic performance and school attendance of the school-aged children.