

Classification and quality of groundwater supplies in the Lower Shire Valley, Malawi – Part 1: Physico-chemical quality of borehole water supplies in Chikhwawa, Malawi

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Abstract

This paper presents data on the physico-chemical quality of groundwater supplies in Chikhwawa, Malawi. Eighty-four water samples were collected and analysed for a range of chemical constituents (Al, As, Ca, Cd, Co, Cr, Cu, Fe, Hg, Mg, Mn, Ni, Pb, Se, V, Zn, K, Na, Cl, F, NO_3^- , SO_4^{2-}), pH, temperature, electrical conductivity and turbidity, from 28 boreholes located in 25 remote, rural villages ($n=3$ per village) distributed along the east ($n=15$) and west ($n=10$) banks of the Shire River. Samples were collected every 2 months during the wet season, over a period of 5 months (December to April). Results were compared with national (Malawi Bureau of Standards Maximum Permissible Levels (MBS MPL)) and international (World Health Organization Guideline Values (WHO GV)) drinking-water standards. In general, most parameters complied with the Malawi Bureau of Standards Maximum Permissible Levels (MBS MPL) for borehole water supplies. The MBS MPL standards for iron, sodium and nitrate were slightly exceeded at a few boreholes, technically rendering the water supply unwholesome but not necessarily unfit for human consumption. In contrast, significantly high nitrate (≤ 200 mg/l) and fluoride (≤ 5 mg/l) concentrations at levels which constitute a significant risk to the health of the consumer were detected in borehole samples in a number of villages and warrant further investigation. Water committee members complained of problems associated with taste (saltiness or bitterness) and appearance (discoloured water) primarily on the west bank, presumably as a result of the high sodium and chloride levels, and precipitation of soluble iron and manganese, respectively. This resulted in some water collectors reverting to the use of surface water sources to obtain drinking-water, a practice which should be dissuaded through the education of water and village health committees.

Keywords: Wholesomeness, fitness for human consumption, borehole water quality, Malawi

INTRODUCTION

The chemical quality of groundwater used for human consumption in developing countries is a significant, but neglected public health issue. In Malawi, like many countries in Africa, abstracted groundwater derived from a 'protected or improved' source is often the main source of 'safe' drinking-water for the poor in rural areas. The fact that water is abstracted from underground and from an 'improved' source is often assumed by the local community to mean that the water is 'safe' for human consumption. However, this is an over-simplification and it should not be automatically assumed that such water is indeed 'safe' for human consumption.

To determine the wholesomeness of water supplies in the developed world, water samples are routinely taken and measured against a range of health and non-health based physico-chemical standards and bacteriological indicators of faecal pollution. The majority of these standards are based on the WHO Health-Based Guidelines Values, which have been adapted and

or amended by governments to derive appropriate National Standards. In Malawi, for borehole water quality to satisfy the requirements of wholesomeness it must be safe from water-borne or associated disease, free from toxic chemicals and be aesthetically and organoleptically acceptable to the consumer (MBS, 2005). In addition, compliance is also required with respect to Malawi Bureau of Standards (MBS) derived maximum permissible levels (MPLs) for 17 chemicals in drinking-water and 11 physical and macro-constituent characteristics.

Monitoring of drinking-water quality is an expensive exercise and is usually only undertaken on a regular basis by statutory suppliers of drinking-water to large conurbations. Regular monitoring of small community water supplies such as boreholes in remote, rural areas of developing countries is unrealistic. Although monitoring is important, it should not be undertaken at the expense of maximising the provision of additional 'safe' sources of water supplies to communities that access their drinking-water from unprotected sources (WHO, 2010).

In Malawi, the Ministry of Irrigation and Water Development recommends that upon construction of a borehole, and before maintenance and control is officially handed over to the community, a small number of water quality tests are undertaken, i.e., pH, total dissolved solids, sulphates, nitrates, fluoride, chloride, electrical conductivity and iron

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