*Second RUFORUM Biennial Meeting 20 - 24 September 2010, Entebbe, Uganda*

Research Application Summary

# Assessment of water quality in Mohale dam and associated rivers in Lesotho

Mating, R.[1], Olaleye, A.O.[1] & Johanne, M[2]
[1.] Department of Soil Science & Resource Conservation, The National University of Lesotho, Roma, Lesotho
[2]Department of Livestock Registration, Roma, Lesotho
Corresponding author: ao.olaleye@gmail.com

## Abstract

The study assessed Mohale dam and the associated rivers' water quality over 5 years and comparing it to the water quality standards. It was believed that since this dam and the rivers occurred at elevations of between 2000m and 2900m above sea level, there was minimal anthropogenic pollution. Monthly data of the dam and the rivers water quality for the period 2003-2008 on pH, electrical conductivity (EC), potassium (K), sodium (Na), calcium (Ca), magnesium(Mg) and turbidity were collected from the Lesotho Highlands Authority (LHDA) database. In 2009 data for base cations (K, Na, Ca and Mg) and heavy metals (Fe, Cu, Zn, As and Pb) content were collected. The results showed that during the period 2003-2008, across sites and years, the pH and mean concentration of base cations were below the minimum permissible levels (mpl). However in 2009 Ca concentration had risen to values >200mg/l while the levels of heavy metals, i.e., Fe, Cu and Zn were still lower than mpl, those of As and Pb were higher than mpl. The most important water quality variables differed across sites and, as such, their close monitoring is required in order to prevent their likely built up that may pose danger to health of the nation and associated countries.

Key words: Anthropogenic pollution, heavy metals, Lesotho, water source

## Résumé

L'étude a évalué le barrage de Mohale et la qualité de l'eau des rivières associées pendant plus de 5 ans et la comparant aux standards de la qualité de l'eau. On croyait que, comme ce barrage et les rivières ss situent à une altitude comprise entre 2000m et 2900m au dessus du niveau de la mer, il y avait un minimum de pollution anthropique. Les données mensuelles du barrage et de la qualité de l'eau des rivières pour la période 2003-2008 sur le pH, la conductivité électrique (CE), le potassium (K), sodium (Na), calcium (Ca), magnésium (Mg) et la turbidité ont été recueillies à partir de la base des données de l'administration des régions montagneuses de Lesotho (LHDA).

En 2009, les données pour les cations basiques (K, Na, Ca et Mg) et le contenu des métaux lourds (Fe, Cu, Zn, As et Pb) ont été collectés. Les résultats ont montré que, durant la période 2003-2008, à travers les sites et les années, le pH et la concentration moyenne de cations basiques ont été inférieurs aux niveaux minimaux admissibles (MPL). Cependant en 2009 la concentration en Ca avait augmenté à des valeurs> 200 mg / l tandis que les niveaux de métaux lourds, à savoir, Fe, Cu et Zn étaient encore inférieurs aux niveaux minimum admissibles (MPL), ceux de As et Pb ont été plus élevés que MPL. Les variables les plus importantes de la qualité de l'eau varient selon les sites et, en tant que tels, leur surveillance étroite est nécessaire afin d'empêcher leur susceptible accumulation qui peut présenter un danger pour la santé de la nation et des pays associés.

Mots clés: Pollution anthropique, métaux lourds, Lesotho, source d'eau

## Background

The most important natural resource of Lesotho is the abundant water supply. Annual rainfall of up to 1000mm is frequently recorded in the highlands. The abundant supply of good quality water in the highlands of Lesotho led to the identification of the Lesotho Highlands Water Project (LHWP) more than 40 years ago. The project's aim was to export water to the Republic of South Africa and to generate hydropower within Lesotho (LHWP Mohale Dam, 2008). Through the LHWP, there are three main water reservoirs in Lesotho namely, Mohale dam, Katse dam and Mmuela dam.

## Literature Summary

The quality of water used to irrigate crops has great effect on soil fertility, seed germination, plant growth and plant susceptibility to pests and diseases. Water pollution is a major threat to most water bodies due to urbanization and population increases (Odjugo and Konyeme, 2008). Urbanization and population increases contribute to water pollution through increased vehicle trafficking, increased number of houses and tar roads, increased waste disposal and poor agricultural practices (Cobourn and Segale, 2003; Ali, 2008). The pollutants then find their way into water bodies through direct pumping, deliberate channeling, overland flow and inflow (Odjugo and Konyeme, 2008). Transfer of heavy metals from water to humans may be through soil and subsequently through plants. Water quality criteria include pH, chemical oxygen demand, biochemical oxygen, total dissolved solids (TDS) and electrical conductivity (EC) and there are guidelines for different uses of water. Water quality guidelines

are acceptable concentrations of substances that can be consumed by people and concentrations above these are considered dangerous to human life (WHO, 2006).

## Study Description

The study was carried out in the Mohale catchment in Maseru, Lesotho. The catchment houses the Mohale dam and stretches to the following rivers; Jorodane, Bokoaneng, Bokong, Likalaneng and Senqunyane. It is approximately 938 $km^2$ in size. It is situated at an elevation of 2296 m above sea level (Mwangi, 2007). Data for water quality was collected from the LHDA database for the period 2003-2008. Water samples were collected from the dam edge and taken for laboratory analyses. They were then analyzed for pH, EC, Phosphate, water soluble calcium (Ca), magnesium (Mg), sodium (Na), manganese (Mn), lead (Pb), zinc (Zn), copper (Cu), arsenic (As), cadmium (Cd), chromium (Cr) and iron (Fe).

**Table 1. Analysis of Mohale Dam water over years compared with WHO standards.**

| Parameter | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | WHO |
|---|---|---|---|---|---|---|---|---|
| Ca (mg/l) | 9.02 | 8.57 | 9.72 | 8.77 | 6.75 | 9.38 | 209.20 | 200 |
| Mg (mg/l) | 3.10 | 2.92 | 3.18 | 3.09 | 2.40 | 3.61 | 5.84 | 200 |
| Na (mg/l) | 36.09 | 1.94 | 1.43 | 1.63 | 1.85 | 2.95 | 8.59 | 200 |
| K (mg/l) | 1.90 | 0.28 | 0.27 | 0.36 | 0.27 | 0.15 | 3.12 | No guideline |
| As (mg/l) | _ | _ | _ | _ | _ | _ | 0.12 | 0.01 |
| Pb (mg/l) | _ | _ | _ | _ | _ | _ | 0.07 | 0.01 |
| Cu (mg/l) | _ | _ | _ | _ | _ | _ | 0.01 | 2.0 |
| Fe (mg/l) | _ | _ | _ | _ | _ | _ | 0.01 | 0.3 |
| Zn (mg/l) | _ | _ | _ | _ | _ | _ | 0.03 | 3 |
| EC (mg/l) | 8.55 | 7.89 | 7.64 | 7.20 | 5.02 | 7.89 | _ | 1.5 |
| pH (in water) | 8.20 | 7.67 | 8.17 | 7.68 | 6.12 | 8.24 | _ | 6.5-8.15 |
| Turbidity | 2.73 | 1.87 | 2.75 | 4.23 | 4.24 | 2.30 | | 5 |

## Research Application

During the period 2003-2008 the water quality of Mohale dam and associated rivers remained good and posed no threat to consumers. However by 2009 Ca, As and Pb concentrations had risen to levels that are higher than minimum permissible levels and this poses danger to consumers.

The study clearly showed that the Mohale dam and its inflows were not as free from contaminants as many had thought. The water from Mohale dam contained toxic and carcinogenic levels of Arsenic (0.01mg/l), Calcium (>200mg/l) and Lead (>0.01mg/l) and had high salinity levels (EC>1.5mS/cm). This water is therefore deemed to be detrimental to both human and plant health as it is likely to cause cancer and other diseases in humans and reduce plant yield. The results of this study suggest that

human factors and natural conditions of geology may have influenced the levels of contaminants in the dam. The LHWP should interpret the water analysis results often and warn users of this water about the possible hazards of putting such water to certain uses. Pollution control measures such as proper management of grazing areas and control of fuels used for boats in the dam should be taken to protect the dam water quality from further degradation.

## References

Ali, M. S. 2008. Land pollution. Edward's College Peshawar. Available at http://en.wlikipedia.org.

Cobourn, J. and Segale, H. 2003. Where does Tahoe's water pollution come from?" The Lake Tahoe Report. Tahoe Environmental Research Centre.

LHWP Mohale Dam, 2008. Available at: http://www.lhwp.org.ls/engineering/phase1b/mohaledam/default.htm.

Mwangi, G.O. 2007. Environmental change and human security in Lesotho: The role of Lesotho highlands water project in environmental degradation. pp. 59-68.

Odjugo, A.O.P. and Konyeme, J.O.2008. The impact of urban, environment and seasonality on the quality of Ikpoba river in Benin City, Nigeria. *Journal of Food, Agriculture and Environment* 6(2):362-369.

World Health Organization (WHO), 2006. Guidelines for drinking water quality. 3rd edition. Retrieved from: www.who.int pp. 03-19.