42nd WEDC International Conference

ONLINE: 13 – 15 September, 2021

EQUITABLE AND SUSTAINABLE WASH SERVICES:
FUTURE CHALLENGES IN A RAPIDLY CHANGING WORLD

Drinking water access, quality and handling in the Hawassa Basin, Ethiopia

D. Patrissi, R. Meierhofer, A. Ambelu, P. Molnar & C.Valsangiacomo

Switzerland & Ethiopia

REFERENCE NO. 3154

Introduction

In Ethiopia, climate change-related health problems, such as mortality and morbidity due to droughts, floods and waterborne diseases are increasing (Simane, *et al.,* 2016). Ethiopia is a drought- and famine-prone country and has 150 times less reservoir storage per capita than North America and its climate and hydrological variability takes a 38% toll on gross domestic product (Grey, *et al.,* 2007). In view of increasing challenges to provide access to sufficient water of satisfactory quality also in Ethiopia, the goal of this study was to assess the water supply situation in the hydrological basin of Hawassa, a town situated in the Rift Valley. The study included a hydrological assessment of the water resources in the whole basin, evaluated the quality of water supplied at different points in the supply chain and looked at determinants of water handling at the household level. Hawassa is located in a collapsed caldera and the homonymous perennial lake occupies the central part of the basin. The lake and basin are endorheic with no surface water outflow and the freshness of the water in the lake is maintained due to groundwater exchange (Ayenew, 2001).

Methods

An estimation of the hydrological water balance using rainfall and other meteorological parameters from climate reanalysis data was performed to find periods of water storage and depletion in the hydrological basin of Hawassa. This approach is increasingly used in areas where gauging stations do not exist or are sparse (Peña-Arancibia, *et al.,* 2013). Various climate reanalysis datasets, which use atmospheric and land surface modelling assimilated with historical data to produce estimates of precipitation and evapotranspiration at the Hawassa basin-scale, were used to compute a monthly water balance. Since the Hawassa basin is endorheic, the amount of water leaving the catchment as surface runoff can be assumed to be zero. Groundwater inflow from adjacent basins is not present due to elevation differences with neighbouring catchments of the Rift Valley (Ayenew and Tilahun, 2008). Therefore, the water available in the basin which is being stored in the lake and aquifer can be estimated by subtracting evapotranspiration (ET) and groundwater outflow (GWout) from precipitation (P) at a monthly timescale. All combinations of P - ET for six different datasets of precipitation and ET were tested. As a result, a first-order storage approximation referring to the climatology $\Delta S = P - ET - GWout$ from a typical year of the last decade was computed. A qualitatively comparison whether periods of water storage (surplus) and deficit agree with citizens perceptions has been performed. The water balance computations were conducted so that periods of water surplus/deficit can be identified, and that water use for various purposes can be confronted with renewable water availability.

Three areas in the basin were selected to assess water quality and water handling determinants: Dato kebele and Tabor kebele and one rural area named Gemeto. The water for these communities is abstracted from groundwater wells (sources) and is pumped to reservoirs located at higher elevation. Water is manually chlorinated and delivered by gravity supply to the communities. The frequency of chlorine disinfection is determined by the operator with a key, based on visual inspection of the amount of water in the reservoir. Around 200 water samples were collected at the sources (8), the reservoirs (6), water points (42), and at the

point of consumption in the households (141). In parallel with the water quality analysis, 149 household interviews were conducted to further investigate people's habits in handling drinking water and assess their risk perception regarding water quality. At the beginning of every interview, the respondent was informed that the results will be treated anonymously, that participation is voluntary and was asked for oral consent. Multivariate logistic regression models were calculated to assess the association of water handling factors, risk perception and water availability on diarrhoea and the self-declared use of household water treatment.

Results

The assessment of the hydrological water balance revealed a shortage of water between April and August. These findings were confirmed during household interviews, where people indicated challenges in accessing sufficient water during the same months. Water quality analysis revealed the presence of a mean 41 CFU/100ml *E. coli* (SD=50) at the point of abstraction. Reservoirs were free of *E. coli.* At the point of consumption in the households, *E. coli* bacteria were found in almost half (47%) of the samples (Mean=8 CFU/100ml; SD=22). This indicates *E. coli* contamination between the reservoirs and the point of consumption. The survey revealed that 56.4% of households consider the water quantity adequate, 14.1% said that they use a method for household water treatment (HWTS) and 16.1% reported diarrhoea in the past two weeks. The use of HWTS was significantly associated with considering water treatment worthwhile (OR=2.7, p=0.045, 95% CI=1.0-7.1) and perceiving the risk of getting sick when consuming untreated water (OR=2.7, p<0.000, 95% CI=1.6-4.4). Reduced diarrhoea was significantly associated with higher education (OR=0.4, p=0.008, 95% CI=0.2-0.8), having access to sufficient water quantity (OR=0.2, p=0.006, 95% CI=0.1-0.6) and declaring to use HWTS (OR=0.1, p=0.048, 95% CI= 0.0-0.9).

Conclusions

Low-hygiene standards and environmental conditions make it often difficult to prevent water from recontamination. While HWTS was associated with reduced diarrhoea, it is only practiced by a minority of households. This may be because people trust the water quality furnished by the authorities and consider it safe for consumption since they pay for it. The currently low risk perception in the community leaves room for hygiene promotion campaigns. Alternatively, free residual chlorine in the supply scheme could provide a residual disinfectant, but a more consistent chlorination practice should be performed by authorities to provide reliable protection against recontamination.

References

AYENEW, T., 2001. Numerical groundwater flow modeling of the central main Ethiopian Rift lakes basin. SINET: Ethiopian Journal of Science 24, 167–184.

AYENEW, T., TILAHUN, N., 2008. Assessment of lake-groundwater interactions and anthropogenic stresses, using numerical groundwater flow model, for a Rift lake catchment in central Ethiopia. Lakes & Reservoirs: Research & Management 13, 325–343. https://doi.org/10.1111/j.1440-1770.2008.00383.

GREY, D., SADOFF, C.W., 2007. Sink or Swim? Water security for growth and development. Water Policy 9, 545–571. https://doi.org/10.2166/wp.2007.021.

PEÑA-ARANCIBIA, J.L., *et al.,* 2013. Evaluation of Precipitation Estimation Accuracy in Reanalyses, Satellite Products, and an Ensemble Method for Regions in Australia and South and East Asia. J. Hydrometeor. 14, 1323–1333. https://doi.org/10.1175/JHM-D-12-0132.1.

SIMANE, B., *et al.,* 2016. Review of Climate Change and Health in Ethiopia: Status and Gap Analysis. Ethiop J Health Dev 30, 28–41.

Contact details

Donato Patrissi is an Environmental Engineer, specialising in Water Resources Management at ETHZ. Since 2019, Donato has been working as WASH Project Manager on water disinfection in Hawassa in collaboration with SUPSI, SAED NGO and Hawassa University.

Donato Patrissi: Via Cimabue 7/A, 10137, Torino, Italy. Telephone: +393489643144.
Email: donato.patrissi@supsi.ch
Website: https://www.linkedin.com/in/donato-patrissi-7a8b06128/
Claudio Valsangiacomo: Email: claudio.valsangiacomo@supsi.ch