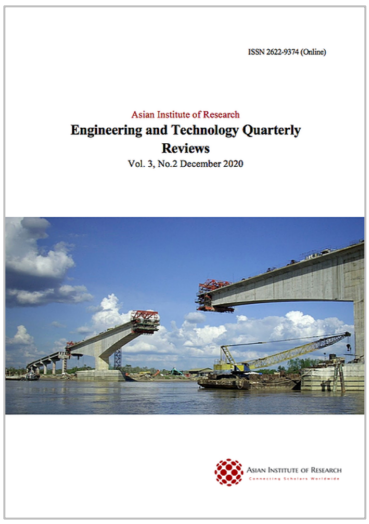

Engineering and Technology Quarterly Reviews

Matsimbe, Jabulani. (2020), Comparative Study of Water Quality From Boreholes and Hand-Dug Wells: Case of Namatapa in Bangwe Township. In: *Engineering and Technology Quarterly Reviews*, Vol.3, No.2, 67-73.

ISSN 2622-9374

The online version of this article can be found at:
https://www.asianinstituteofresearch.org/

Published by:
The Asian Institute of Research

The Asian Institute of Research *Engineering and Technology Quarterly Reviews* is a peer-reviewed International Journal. The journal covers scholarly articles in the fields of Engineering and Technology, including (but not limited to) Civil Engineering, Informatics Engineering, Environmental Engineering, Mechanical Engineering, Industrial Engineering, Marine Engineering, Electrical Engineering, Architectural Engineering, Geological Engineering, Mining Engineering, Bioelectronics, Robotics and Automation, Software Engineering, and Technology. As the journal is Open Access, it ensures high visibility and the increase of citations for all research articles published. The *Engineering and Technology Quarterly Reviews* aims to facilitate scholarly work on recent theoretical and practical aspects of Education.

ASIAN INSTITUTE OF RESEARCH
Connecting Scholars Worldwide

ASIAN INSTITUTE OF RESEARCH
Connecting Scholars Worldwide

The Asian Institute of Research
Engineering and Technology Quarterly Reviews
Vol.3, No.2, 2020: 67-73
ISSN 2622-9374

Comparative Study of Water Quality From Boreholes and Hand-Dug Wells: Case of Namatapa in Bangwe Township

Jabulani Matsimbe[1]

[1] Department of Mining Engineering, Faculty of Engineering, The Polytechnic, University of Malawi, Blantyre, Malawi. Email: jmatsimbe@poly.ac.mw

Abstract
Access to safe drinking water is a major problem in Malawi. Residents in Bangwe Township use water from boreholes and hand-dug wells for consumption. The question that arises is how safe is this water. Present study seeks to comparatively assess water quality from boreholes and hand-dug wells located at Namatapa, Bangwe Township. Water samples from two boreholes at 1 km apart and two hand-dug wells at 1.1 km apart were analysed for physicochemical and biological parameters using recommended methods. Sampling was done in the wet season over a period of three months. Results showed that coliforms exceeded the recommended guideline values for drinking water according to World Health Organisation and Malawi Bureau of standards. Values in excess of 462 cfu/100 ml and 10 cfu/100ml were observed in hand-dug wells and boreholes respectively. Suspended solids, Turbidity, pH, Nitrate and Total dissolved solids were all within the acceptable limits. The study results demystify the community belief that borehole water is always safer than hand-dug well water. Therefore, there is a need for authorities to provide portable water in the area so that residents should stop consuming untreated water from boreholes and hand-dug wells.

Keywords: Coliforms, Groundwater, Malawi, Physicochemical

1. Introduction

Access to portable water sources in rural and urban areas remains a serious challenge in many developing countries like Malawi (Mtewa et al. 2018). Water quality research done on communally shared water points in Lilaka, Mvula, Chikunda, Namiyango and Ntopwa of Bangwe township has shown that water from boreholes and wells exceeds the recommended guideline values for drinking water according to World Health Organisation, Malawi Bureau of standards and Ministry of Water development (Kaonga et al. 2013; Mtewa et al. 2018; Mkandawire T & Banda E 2009). There is no literature on the water quality of borehole and hand-dug well in Namatapa area, Bangwe Township. In addition, residents in the area think boreholes are a source of portable water as compared to hand-dug wells. Consumption of poor quality water majorly threatens the health of millions of people worldwide (Adekunle et al., 2007). Kalua and Chipeta (2005) reported that in Malawi, nearly 50% of all illnesses are related to waterborne diseases. From 2004 to 2005 and November 2007 to December 2007 Bangwe clinic registered 263 and 85 cholera cases, respectively, which was the highest level recorded by both peri-urban and rural clinics in Blantyre (Kaonga et al. 2013). Groundwater accounts for about 88% safe drinking water in rural areas where there is widely dispersed population and water treatment infrastructure and transportation does not exist (Alexander, 2008). Present study seeks to comparatively assess the water quality of

boreholes and hand-dug wells in Namatapa area. It is hoped that the output of this study will help update the water quality database on some overlooked areas like Namatapa in Bangwe Township (Figure 1, 2 and 3).

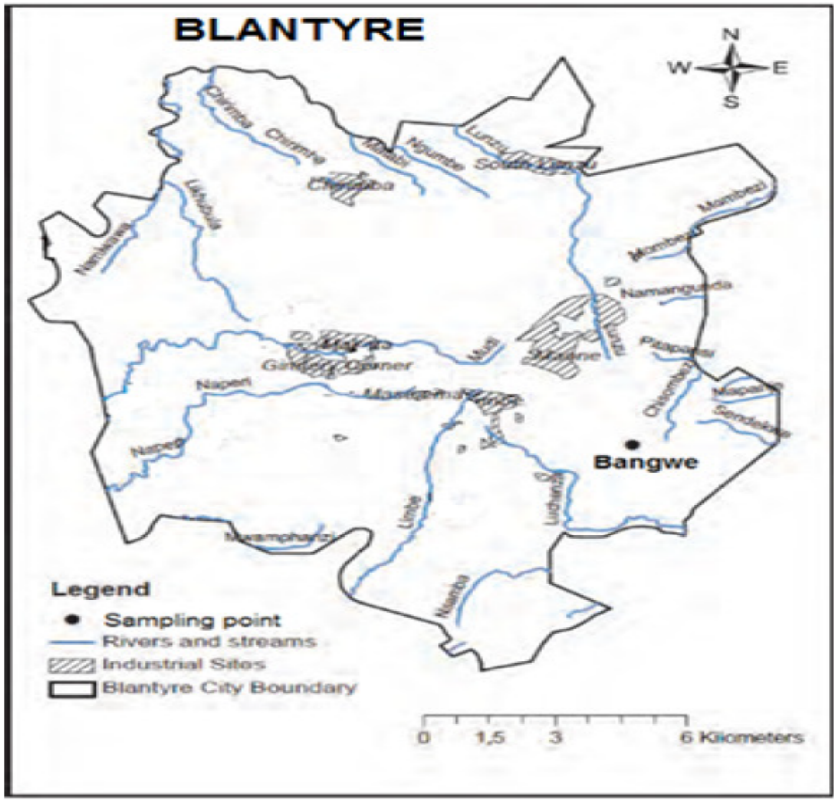

Figure 1. Map of Bangwe Township showing location of Namatapa area

Figure 2. Borehole #1 and #2

Figure 3. Hand-dug well #1 and #2

2. Materials and Methods

Study Area

Namatapa lies on Latitude -15.822806° and Longitude 35.074804°. Within its vicinity is Namatapa primary school, Namatapa youth centre, Namatapa market, Jannat Mosque and Pentecost church. Borehole #1 and Well #1 is located close to Namatapa primary school while Borehole #2 and Well #2 are located close to Jannat Masjid Mosque (Figure 4). The area is of particular importance due to availability of essential services whose users consume water from the boreholes and wells.

Figure 4. Satellite view of Namatapa area, Bangwe Township (Google Earth, 2020)

Sampling

Borehole and hand-dug well water samples were taken in sterile containers from two different locations around and within Namatapa. Water samples (in triplicates) were taken in the wet season (November 2019, December 2019, January 2020) so as to balance seasonal water quality patterns that might vary on localities.

Samples were transported to the Quality Control Laboratory at The Polytechnic for immediate analyses in accordance with standardized methods (APHA, 2017; WHO, 2011). All laboratory analyses were started on the

same day of sample collection. For each of the chemical parameters, 10 ml of the sample was dispensed into the cuvettes and the corresponding chemical reagents added (in accordance with the manufacturer's specification). Corresponding measurements were read-off the LCD display. The turbidity, pH and total dissolved solids were measured using the Hanna microprocessor turbidity meter, Beckman 350 pH meter and HM digital TDS meter, respectively. Filtering and weighing was done for suspended solids. The coliform and Escherichia coli counts were enumerated using the colilert-18 microbiological test kit (Membrane Filtration Technique). Calibration on all equipment was done according to the manufacturer's instructions.

3. Results and discussion

The results are expressed as mean ± standard deviation, n=3. Table 2 shows the mean and standard deviation of borehole and hand-dug well water samples obtained from various locations around and within Namatapa area. The samples were tested for physicochemical and microbiological parameters compared with those recommended by Ministry of Water Development (MWD), Malawi Bureau of Standards (MBS), and World Health Organization (WHO).

The values of suspended solids for borehole and hand-dug well ranged from 0 -1 mg/l thus within those recommended by MWD, MBS and WHO [<30mg/l]. The low values in suspended solids could be due to the fact that all the water sources are covered. Turbidity values for borehole #1 [0.18 NTU], borehole #2 [0 NTU] and well #2 [2.44 NTU] except for well #1 [11.13 NTU] were within the recommended values of MWD, MBS, WHO [25 NTU, 5 NTU, 5 NTU respectively]. According to Inanc et al. 1998, surface runoff and storm water from rainfall can transport pollutants from the surfaces into underground aquifers thereby increasing the turbidity. Table 2 and Figure 5 shows that the pH values for borehole #1 [6.4], borehole #2 [6.16], well #2 [6.82] and well #1 [6.85] were within the recommended ranges of MWD, MBS, WHO [6.0 - 9.5, 6.5 - 9.5, 6.5 - 8.5 respectively]. The pH variations for well and borehole water could be due to solvation of organic matter in the soil matrix surrounding and in contact with the water wells (Mtewa, 2017). The Nitrate levels [0 – 0.5 mg/l] and Total dissolved levels as shown in Figure 6 [138 – 472 mg/l] for all borehole and well water samples were within the acceptable levels of MWD, MBS and WHO.

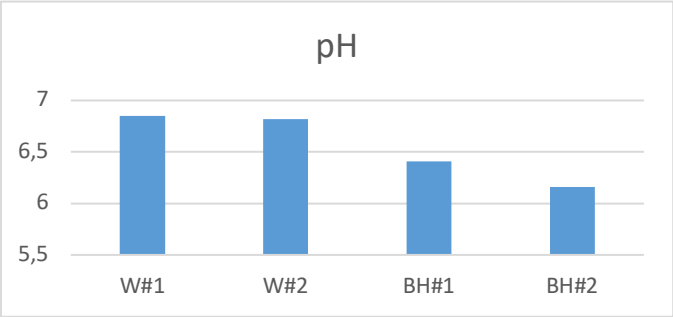

Figure 5**.** pH values for hand-dug well (W#1 & W#2) and borehole (BH#1 & BH#2)

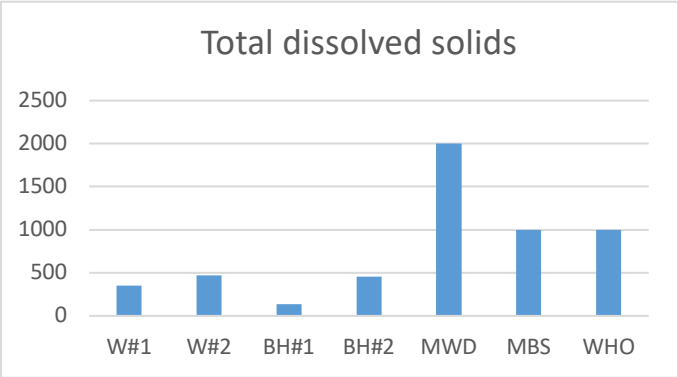

Figure 6. Total dissolved solid values for hand-dug well (W#1 & W#2) and borehole (BH#1 & BH#2) compared to MWD, MBS & WHO

Figure 7 shows that the faecal coliform values for borehole #1 [6 cfu/100ml], borehole #2 [5.7 cfu/100ml] except for well #1 [403 cfu/100ml] and well #2 [70 cfu/100ml] were within the recommended ranges for MWD [50 cfu/100ml]. Figure 8 shows that the total coliform values for borehole #2 [8.3 cfu/100ml], borehole #1 [10 cfu/100ml] except for well #1 [462 cfu/100ml] and well #2 [95 cfu/100ml] were within the recommended ranges for MWD [50 cfu/100ml].

All water samples exceeded the acceptable faecal and total coliform limit recommended by MBS and WHO [0 cfu/100ml]. Since water quality acceptable limits are based on MBS and WHO standards, the borehole and hand-dug well water is not safe for consumption without further treatment. Kaonga et al. 2013 found that faecal contamination is one of the causes of diarrhoea pathogens in less developed countries. According to Efe (2008), the longer water travels through soil formation the cleaner it becomes; this could account for the lower water quality values of borehole water which is at higher depth than well water.

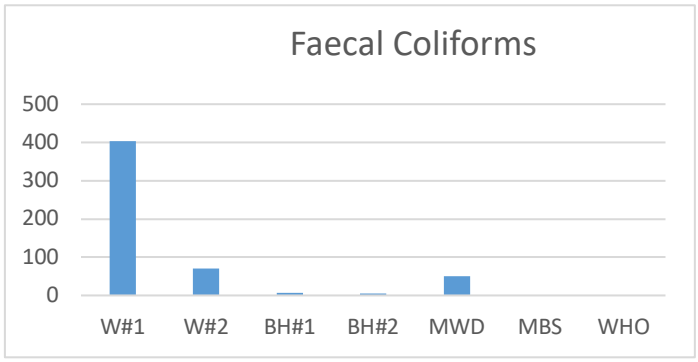

Figure 7. Faecal coliform values for hand-dug well (W#1 & W#2) and borehole (BH#1 & BH#2) compared to MWD, MBS & WHO

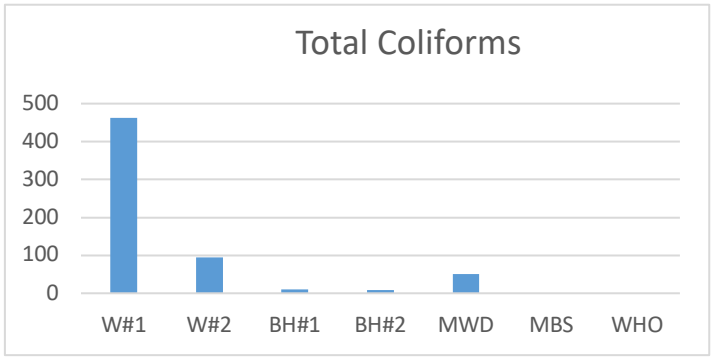

Figure 8. Total coliform values for hand-dug well (W#1 & W#2) and borehole (BH#1 & BH#2) compared to MWD, MBS & WHO

Table 2: Mean ± standard deviation of water quality parameters

Parameter	Units	Sample Site For Well		Sample Site For Borehole		MWD	MBS	WHO
		W#1	W#2	BH#1	BH#2			
Suspended Solids	mg/l	1±1.00	0±0.00	0±0.00	0.3±0.58	30	30	30
Turbidity	NTU	11.13±5.18	2.44±1.98	0.18±0.31	0±0.00	25	5	5
pH	pH units	6.85±0.09	6.82±0.04	6.41±0.08	6.16±0.04	6.0-9.5	6.5-9.5	6.5-8.5
Nitrate	mg/l	0.12±0.01	0.079±0.03	0.076±0.04	0.48±0.40	100	100	45
Total dissolved solids	mg/l	349.2±4.10	471.5±8.91	138.2±7.26	454.9±5.50	2000	1000	1000
Faecal coliforms	cfu/100 ml	403±6.41	70±5.13	6±2.1	5.7±1.6	50	0	0
Total coliforms	cfu/100 ml	462±6.56	95±5.03	10±1.3	8.3±2.4	50	0	0

*cfu: colony forming units.

Random interviews on 20 Namatapa residents showed that 80% of the residents boil the water before consumption while 20% consume the water directly as it appears clean to the eye. It is considered that the process of heating water to a rolling boil, as recommended in the WHO Guidelines for Drinking-water Quality (WHO, 2011), is sufficient to inactivate pathogenic bacteria, viruses and protozoa.

4. Conclusion and recommendations

Many households in Malawi rely on groundwater supplies such as boreholes and hand-dug wells. This study reveals the need to sensitise borehole and well owners about the water quality from these sources as there is a general belief that boreholes are better and safer than hand-dug wells. Meanwhile, depth of water source is considered to be an important factor as most of the parameters that had lower mean values were from borehole samples which are usually deeper than hand-dug wells. Nevertheless, the borehole and hand-dug well water is not safe for consumption as it does not meet the standards recommended by MWD, MBS and WHO.

Conflict of Interest

The author has not declared any conflict of interests.

Acknowledgements

The author would like to thank University of Malawi, The Polytechnic for supporting the research.

References

Adekunle IM, Adetunji MT, Gbadebo AM, Banjoko OB (2007). Assessment of Groundwater quality in a typical rural settlement in southeast Nigeria. International Journal of Environmental Research and Public Health 4(4):307-318.

Alexander P. (2008). Evaluation of ground water quality of Mubi town in Adamawa State, Nigeria. Afr. J. Biotechnol. 7:1712-1715.

American Public Health Association (APHA) (2017). Standard methods for the examination of water and wastewater (23rd Edition), APHA, ISBN 0875532233, Washington DC.

Efe S. I. (2008). Quality of water from hand-dug wells in Onitsha metropolitan area. J. Environ. Sci. 6(23):5-12.

Inanc B., Kinaci C., Sevimli M. F., Arikan O. & Ozturk M. (1998). Pollution prevention and restoration in the Golden Horn of Istanbul. Water Sci. Technol. 37(8):137-144.

Kalua PWR, Chipeta WPC (2005). 'A Situation Analysis of Water Sector in Malawi.' A paper presented at the workshop on Situation Analysis of Water Sector in Malawi.

Kaonga C, Kambala C, Mwendera C, Mkandawire T (2013). Water quality assessment in Bangwe Township, Blantyre City, Malawi. African Journal of Environmental Science and Technology, DOI: 10.5897/AJEST12.196

Malawi Bureau of Standards (2005). Malawi standard; drinking water – specification. Malawi Standards Board, MS 214:2005.

Malawi Government (2005). Ministry of water development and irrigation, National Water Policy. Lilongwe: Ministry of Irrigation and Water Development

Mtewa AGK (2017). Antibacterial potency stability, pH and phytochemistry of some Malawian ready-to-serve aqueous herbal formulations used against enteric diseases. International Journal of Herbal Medicine 5(3):01-05.

Mtewa T, Chauluka F, Mtewa A, Banda L, Kalindekafe L (2018). Water quality assessment of various sources in Periurban areas of Malawi: A case of Bangwe township in Blantyre. African Journal of Environmental Science and Technology, DOI: 10.5897/AJEST2018.254

WHO (2011). Guidelines for drinking-water quality, fourth edition. Geneva: World Health Organization (http://www.who.int/water_sanitation_health/ publications/2011/dwq_guidelines/en/, accessed 13 August 2020).

Mkandawire T, Banda E (2009). Assessment of drinking water quality of Mtopwa village in Bangwe Township, Blantyre. Journal of Desalination, DOI: 10.1016/j.desal.2008.05.101