Physical and Bacteriological Assessment of Treated Water of Usman Dam in Abuja, Nigeria

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ABSTRACT

This study is carried out to assess the quality of the Treated Water from Usman Dam in Abuja by examining the water physical and bacteriological for detection of potentially dangerous water pollution. The research design applied qualitative where Seven (7) water samples were picked from treated water (Storage tanks, public taps and in- house tap) which were analyzed in the laboratory. The data were represented graphically using Microsoft Excel. The results showed all the water samples were colourless; their temperatures within the acceptable standard of NSDWQ regulatory limit of 29^{o}c (ambient) and Turbidity below the maximum acceptable standard of NSDWQ. Whereas the bacteriological results showed that only Treatment plant and in-house tap met the NSDWQ standard for presumptive coliform/MPN/100mL (3 x 10 $^{-2}$ m) While the all samples showed a high concentration of total aerobic bacteria above the maximum of 10CFu/ML recommended by NSDWQ which means the quality of water is not accepted for consumption. To this effect, it is recommended that there should be integrated approach of laboratory testing by catchment areas on regular bases for detection of unwanted water standard.

Keyword: Bacteriological, Coliform, Total Aerobial Bacterial, Physical, Treated water, Usman Dam

1.1 Introduction

Fresh, clean and abundant water is an indispensable resource for life and the supply of good drinking water quality to all citizens by their governments is the major target of the World today of which has propelled the United Nation (UN) to develop a plan of Sustainable Development Goal (SDG) after most countries have failed to achieve the Millennium Development Goal of 2015. The strategy employed for the Sustainable Development Goals (SDGs) is for every country to measure and explore its response to and business of making life conducive for her present and future citizens and also recreating a safe world for all through equipping of every human being with the tools for a decent and healthy living through mutual effort (Ugwu and Ogunremi, 2019). For water, sixth (6th) Sustainable Development Goal (SDG) is to attain availability and sustainability in the management of water and sanitation even as water is a limited resource. By this, more than one sixth of the world's population lack access to safe drinking water sources [Parker et al, 2006]. Climate change (floods and draughts) have affected water availability and surface water quality [UN, 2012; Delpla et al, 2009]. It is estimated that 1.8 billion people (28% of the world's population) use unsafe water in 2010 and that additional 1.2 billion (18% of the

world's population) use water from sources with significant sanitary risks (Friedlander, Puri, Schoonen and Karzai, 2015; Onda, LoBuglio, and Bartram, 2012). Two-fifth of Africans lack improved water supply, 60.2% have access to improved drinking water source, and 36% have access to improved sanitation facilities (Eneh and Eneh, 2014).An estimate made by Water Aid, (2017) shows that 57 million Nigerians still lacked access to basic sanitation and clean water in 2016, while the World Health Organization (WHO) has estimated that about 361,900 people die yearly due to poor water and sanitation conditions in Nigeria. The lack of safe water creates a remarkable burden of diarrheal disease and other debilitating, life-threatening illnesses for people in the developing world (Sobsey et al, 208). Water intended for consumption, preparation of food and drinks or for personal hygiene should not contain agents pathogenic for humans (WHO, 1996).However, varieties of microorganisms continue living in water including bacteria, fungi, protozoa, algae and viruses, where they form a complex ecosystem whose dynamics are usually difficult to understand (Chrsanthus, 2014). Those varieties of microbes play an essential role for contamination of water and results in a variety of outbreaks of diseases and death (Chrsanthus, 2014). The presence of fecal coliforms in water is a hint of a potential presence of pathogenic microorganisms, which might cause water borne diseases (Kulshrestha and Sharma, 2004).

Based on several studies, different magnitude and requirement to avert the danger of water shortage, water dehydration and disease outbreak and the focus of this study settle on Physical and bacteriological tests offering the most delicate test for detection of recent and therefore potentially dangerous water pollution (Anochie, Onyeozirila and Onyeneke, 2018). The physical parameter include: temperature of water, some of the important physical and biological characteristics of water, such as density, solubility, odour, chlorination, chemical reactions, growth of bacteria, biochemical oxygen demand (BOD) among others are temperature dependent (Rao, 2002); Colour of water gives the appearance of being unfit for drinking, even though the water may be perfectly safe for public uses. Colour can indicate the presence of colloidal particles, substances in solution, decaying vegetation, organic matter, inorganic salts, dyes and other compounds. Dissolved substance could impact true colour while suspended solids causes' apparent colour (Keller, 1997); Turbidity is expressed as Nephelometric Turbidity Unit (NTU). It is important in water quality assessment for aesthetic and health reason since it is associated with micro-organisms. Turbidity causes undesirable taste and odour and it adds to the chlorine demand of natural surface water during treatment. Water of good quality has a no or low coliform and total bacterial count fewer than 100 cfu per milliliters. Since safe drinking water is essential for good health, drinking water must be free of pathogens.Even though a water supply may pass all laboratory tests, there are tendencies that hazard may arise from pollution of the water source through cross-connection, back symphonage, leaks in mains, service reservoirs, pipes among others. This study is investigating the quality of treated water based on the physical and biological parameters in Usman Dam.

1.2 Materials and Methods

1.2.1 Study Area

Abuja, Federal Capital Territory (FCT), Nigeria is located between latitude 8°25' and 9°25' North of the Equator and longitudes 6°45' and 7°45' East of Greenwich. The boundaries starting from the village called Izon on 7° east longitude and 9°15' latitude, project a straight line West-ward to point of Lehu on the Kemi River, then project a line along 6°47.5 southwards passing close to the village called Semusu, Zui and Bassa down to a place a little well of Abji in Kwara

State. A line along the parallel, 8º27½' North latitude to Aluza village 7º6' East longitude with a line northwards joining the village of Idu, Karshi, and Karu from the line should proceed along the boundary between North-central and North-Western State up to a part of just North of Bwari village. This covers straight to Zuba village and their straight to Izon (FCT, Act 1976).

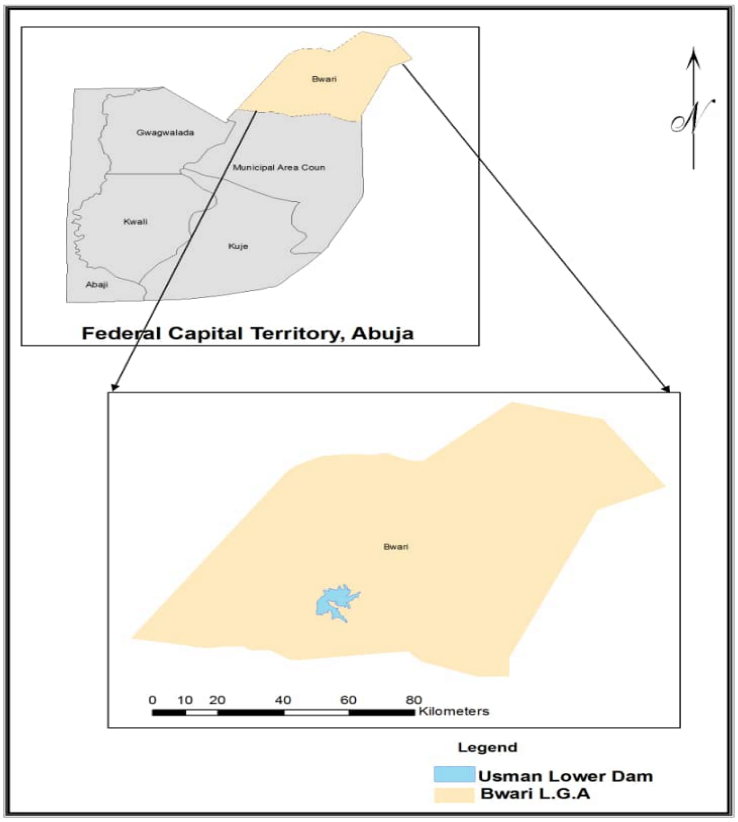


Figure1: Map of Abuja (FCT) showing Usman Lower Dam in Bwari District

The River Usuma is one of the West North flow tributaries of the Gurarariver in Abuja rise in the belt of highland running along the entire eastern boundary of the territory. In the FCT whereUsuma dam is located at Bwari District experiences three weather conditions annually; warm, humid rainy seasons and a blistering dry season. In between the two, three is a brief interlude of harmattan occasioned by the north-east trade wind, with the main feature of dust haze, intensified coldness and dryness.The Usuma Dam and the Treatment Plant came into operation in 1986, and were managed by the Water and Sewage Division of the Engineering Department of the Federal Development Authority to ensure the supply of potable water of adequate quantity and quality for the territory at an economic rate, and harness all water resources of the territory for economic development.

1.2.2 Water Sampling and Field work

Sampling was specifically on the treated water meant for processing and delivery to the inhabitants of FCT Abuja for their domestic used and consumption. Samples of water were collected for both Physical and biological parameter analysis. The procedure employed in the collection of seven (7) water samples and the locations of the various sample points was sterilizing plastic bottles of 250ml were used for the collection of water samples.The caps of the sterilized bottles were removed after water had been extracted from the each location and the bottles were rinsed with the dam water before being filled, leaving some space at the top for air, then, immediately covered after filling. This was made for coolers containing ice for the storing of the water samples. This was to maintain a water temperature of at least 5^{o}c prevent excessive growth or death of the parameters in the water. The same was done for PH at collection point to avoid modification to occur.

Table 1: Sample Points for Treated Water of Usman Treatment Plant

Locations of Point	Activity
Treatment Plant Storage Tank After Treatment Storage Tank Kubuwa Storage Tank Bwari	Processing
Public Tap Bwari In house Tap Public Tap Kubuwa	Delivery

Source: Field Survey, 2020

Due to the sharing of water sources with domestic animals, the sanitation and the standard is assumed to be low even after treatment from the water treatment plant of Usman Dam. The region being the Federal Capital Territory (FCT) of Nigeria needs quality and availability of safe water to the residents and to also avoid consumption of contamination. The study adapted Nigerian Standard of Drinking Water Quality [NSDWQ] for 2015 (NSDWQ, 2015) to compare with the treated water from the seven sampled points. Table 2 shows the NSDWQ recommended drinking water standard for Nigeria which is acceptable standard comparablewith WHO and others.

Table 2: Recommended Standard by NSDWQ for Physical and Bacteriological

Parameter	Unit	Maximum Permitted Levels
Temperature	^{0} Celsius	Ambient 38^{0}C
Colour	TCU	15
Turbidity	NTU	5
Presumptive Coliform	Cfu/100mL	0
Total Aerobic Coliform Count	Cfu/mL	10

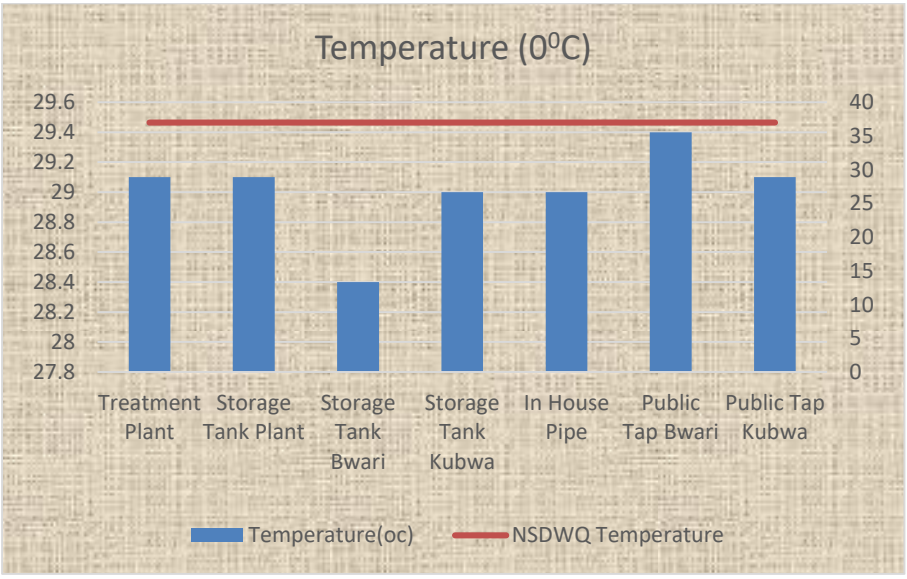
NSDWQS, 2015

1.2.3 Laboratory Analysis

An examination of water qualify involved the physical and biological constituents of treated water of Usman Treatment Plant (Dam). Physical parameters were analysed by standard procedures. Physical parameters such as pH, temperature, and EC were measured using a portable digital pH meter, a thermometer, and an EC meter, respectively, at sites of sample collection. Turbidity of the samples was determined using a turbidity meter in the laboratory. Total aerobic bacterial count and presumptivecoliform were carried out by membrane filtrationtechnique (15). A sterilized pad dispenser was used to introducethe growth absorbent pads into the base of Petridishes, and the growth pads were saturated with the LaurylSulphate Broth. 100 ml water sample was filtered using amembrane filter (0.45 µm) in a vacuum filtration apparatus,and all the filters were transferred to the absorbent padwhich was saturated with the broth. ,e Petri dishes wereincubated at 37C for 4 hr for resuscitation to recoverphysiologically stressed coliforms before incubation. ,enafter, plates for total aerobic bacterial count coliform and presumptive coliform were incubated at 37°C and 44C, respectively, for24 hrs, and then colonies were counted and recorded [15] for each of the seven (7) sampling point were compared with Nigerian Standard for Drinking Water Quality [NSDWQS] in (NSDWQ, 2015).

1.3`RESULT AND DISCUSSION

The result of investigating the physical and bacteriological parameters in the quality of treated water of Usman treatment plant for delivery of safe drinking water by National Standard for Drinking Water Quality (NSDWQ) for creating awareness on the suitability or otherwise of drinking water quality standard all over the universe and meeting sustainable development goal on water and sanitation. The physical characteristic of the samples analysed are colour, temperature, and turbidity. However, the water was colourless and odourless. Temperature of the seven selected sites revealed that was within the acceptable standard of NSDWQ regulatory limit of 29^{o}c (ambient) as seen in figure 2.



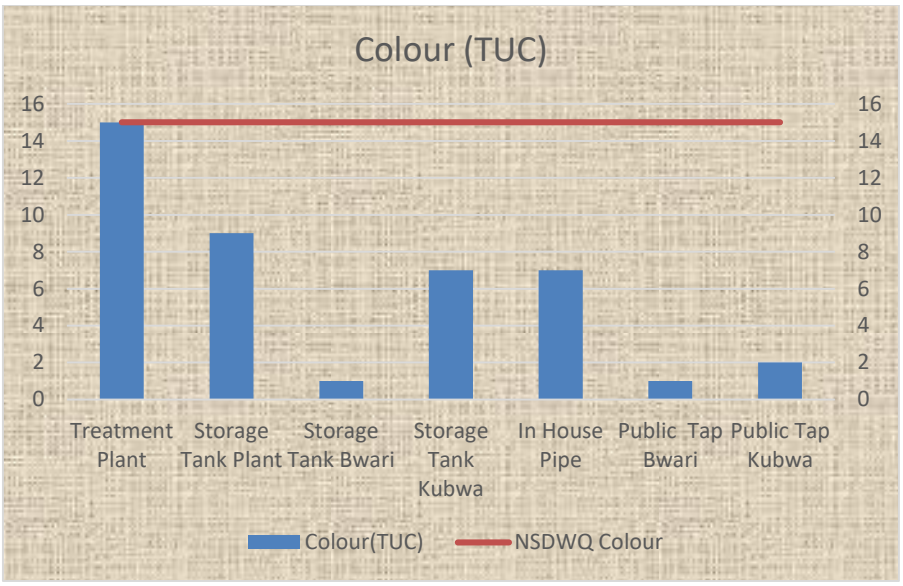


Figure 3: Samples of Colour (TUC) Water Compared with NSDWQ

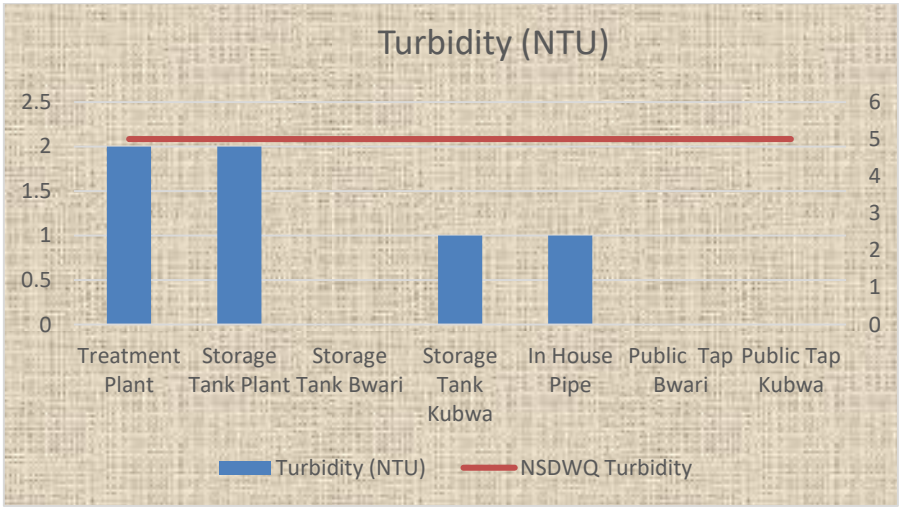


Figure 4: Samples of Turbidity (NTU) Water Compared with NSDWQ

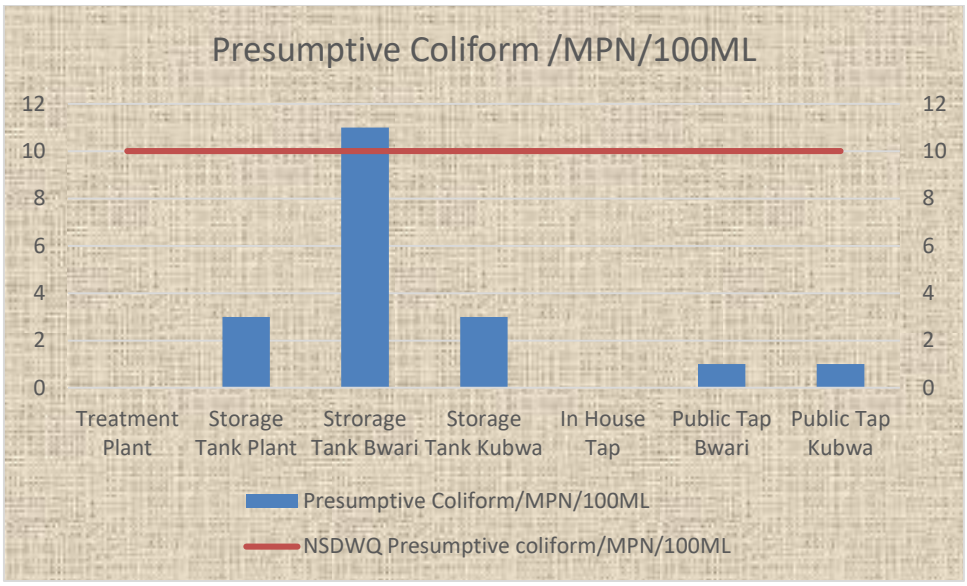


Figure 4: Samples of Presumptive Coliform/MPN/100ml Water Compared with NSDWQ

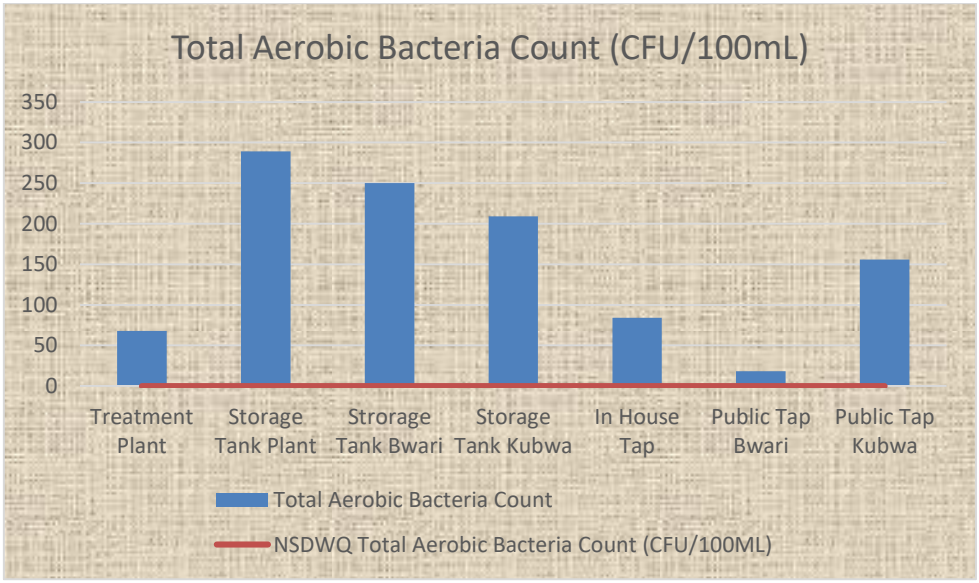


Figure 5: Samples of Total Aerobic Bacteria Count (CFU/100ml Water Compared NSDWQ

Similarly, earlier studies inDamites, et al, (2014) and Kassahun,(2008) reported a mean temperature of21.3 C and 23.8 C, respectively. In Savannah region, the climate ischaracterized by high temperature and an average rainfall, and thesefactors might have contributed to the high temperaturerecords of water samples from different location points of treated water. The colour (TCU) of the water sample fall between 1-32TCU and the NSDWQ standard within the range value of 0-50TCU which is seen figure 3 with only the treatment plant have exactly NSDWQ standard with the rest of the sampled points were below and acceptable standard of drinking water. The turbidity of the water samples for the study range between 0-2NTU of 100% accepted standard of NSDWS (figure 4). The bacteriological parameters for the seven (7) water samples selected in the lower Usman Dam. The result revealed presumptive coliform MPN/100mL (17,3

11, 3,1 and 1) of figure 5 did not meet the NSDWQ standard, only Treatment plant (sample 1) and in-house tap (sample 5) of presumptive coliform/MPN/100mL (3×10^{-2} m). The total aerobic coliform of the seven (7) treated water of Usman Treatment Plant show a high concentration in Cfu/ML above the maximum of 10CFuML recommended by NSDWQ which means the quality of water is not accepted for consumption. This is also similar with the higher bacterial load in the bottled water from Benin,Port Harcourt and Onitsha may be due to the structural integrity of the bottle/container. The Benin, Port Harcourt and Onitsha bottled water is ordinary polyethylene (Anochie, Onyeozirila and Onyeneke, 2018). However, based on observation, rearing of animals and human activities such as fishing, swimming, and some recreational sport contribute immensely to the rate of contamination in lower Usman dam. This is confirmed by the site Engineers, women fetching firewood close to the saddle dam at Ushapa where there is Poultry Industry and some Quarry activities by Chinese Company and SCC Isrealist (Quarrying Industry, all these contributed towards bacteriological contamination. Varieties of microorganisms continue living in water including bacteria, fungi, protozoa, algae and viruses, where they form a complex ecosystem whose dynamics are usually difficult to understand (Chrsanthus, 2014) that could result in illness, diseases and outbreak of communicable diseases experience in the environment.

Conclusion

A significant proportion of the population rely on Usman Dam Treatment Plant for consumption of quality drinking water, industrial and other environmental activities. In view of the challenges discovered with treated water supply, Monitoring of local bodies and catchment areas should apply an integrated approach of laboratory testing on regular bases for detection of unwanted water standard. Routine sanitary impactions on private drinking water system should be conducted to assist residents with information on statuesque of their drinking water quality. Public not sure of the quality of water should boil, allow it to cool before drinking. As a matter of fact the public should be educated on the negative relationship between unclean environment and water quality. The government should be mandated to provide safe drinking water and sanitation to the people in developing countries and also coordinate national and international drinking water standards on unbiased monitoring of water supply from organizations. The products should therefore be properly stored and bacteriological tests of the air quality and environment of the factory should also be carried out regularly. Organization such as Standard Organization of Nigeria (SON), National Standard of Drinking Water Quality (NSDWQ) and the Nigerian National Agency for Food and Drug Administration and Control (NAFDAC) should be proactive in examining water quality before distribution for public consumption.

References

Anochie P. I., Onyeozirila A.C., and Onyeneke E.C. (2018) A comparative bacteriological study of bottled drinking water In Nigeria. *Int J Aquac Fish Sci* 4(4): 045- 050. DOI: http://doi.org/10.17352/2455-8400.000043

Chrysanthus, N. (2014). Bacteriological Quality of Alternative Water Sources in Bambui and Bambili residential areas, North-West Region, Cameroon. *Open Access Libr. J.* 1 (5), 1–6, doi: 10.4236/oalib.1100649.

Damite. D, M. Endris, Y. Tefera et al. (2014) "Assessment of microbial and physic-chemical quality of drinking water in North Gondar Zone, Northwest Ethiopia," *Journal of Environmental and Occupational Science*, 3 (4), 170.

Delpla, I., Jung, A.V., Baures, E., Clement, M. and Thomas, O.(2009). Impacts of climate change on surface water quality in relation to drinking water production, *Environ. Int.*, 35, 1225–1233, doi: 10.1016/j.envint.2009.07.001.

Eneh, O.C. and Eneh, A.N. (2014) Potable water access and management in Africa: implications for poverty, hunger and health. *Technoscience Rev*. 5 (1-2), 3–15.

Friedlander, L.R., Puri, N., Schoonen, M.A., and Karzai, A. W. (2015). The effect of pyrite on Escherichia coli in water: proof-of-concept for the elimination of waterborne bacteria by reactive minerals. *J. Water Health* 13 (1), 42–53, doi: 10.2166/wh.2014.013.

Kassahun, G, (2008)"Physicochemical and bacteriological drinking water quality assessment of Bahirdar town water supply from source to yard connection, North western Ethiopia," M.S. thesis, Addis Ababa University, Addis Ababa, Ethiopia,.

Kulshrestha, H., and Sharma, S. (2006). Impact of mass bathing during Ardhkumbh on water quality status of river Ganga. *J. Environ. Biol.* 27 (2) 437–440.

Onda, K., LoBuglio, J. and Bartram, J. (2012). Global access to safe water: accounting for water quality and the resulting impact on MDG progress. *Int. J. Environ. Res. Public Health* 9, 880–894, doi: 10.3390/ijerph9030880.

Parker, A .A., Stephenson, R., Riley, P.L., Ombeki, S., Komolleh, C., Sibley, L. and Quick, R., (2006). Sustained high levels of stored drinking water treatment and retention of hand-washing knowledge in rural Kenyan households following a clinic-based intervention. *Epidemiol. Infect.* 134, 1029–1036.

Sobsey, M.D., Stauber, C.E., Casanova, L.M., Brown, J.M. and Elliott, M.A., (2008). Point of use household drinking water filtration: a practical, effective solution for providing sustained access to safe drinking water in the developing world. *Environ. Sci. Technol.* 42 (12), 4261–4267, doi: 10.1021/es702746n.

Tebbut, T.H.Y (1990) Basic Water and Wastewater Treatment. London: Butterworth and Co. Publisher. Pp. 10-37.

UN (2012). UN hits water target, but 1.8 billion people still drinking unsafe water, study shows. States News Service, (March 23 2012) Issue.

WHO (1996) Guidelines for Drinking Water Quality, 1, second ed., World Health Organization, Geneva, 173,14–22.