World Journal of Arts, Commerce and Sciences
Vol. 1, No. 2, December 2013, PP: 01 - 06
Available online at http://wjacs.com/

Research article

DRINKING WATER QUALITY AND DETERMINANTS OF HOUSEHOLD POTABLE WATER CONSUMPTION

DesalegnAmenu

College of Natural and Computational Science, Wollega University, P.Box, 395, Nekemte, Ethiopia
E-mail: Wadadesalegn@Gmail.Com

Abstract

The current aim of the Ethiopia‟s Millennium Development Goal declaration is to alleviate poverty through improving the strategy of effective utilization of water supply sources. In order to achieve the goal, a priority area is providing adequate and quality water. The objective of this paper to investigate the reasons behind the use of unprotected sources in both urban and rural settings. In the urban areas people were generally satisfied with the water services provided by the municipality because the water quality was good and walking distances were short. The water cost was considered high especially for the poor who could not afford the cost and therefore used alternative unprotected services. More people in the rural areas did not use the constructed water points because of the quality of water, adequacy, distance and longer waiting times. Sanitation coverage in urban areas was much less than that in rural areas where more extension and promotion has been conducted. Construction of latrines without waste decomposition or removal mechanisms service and the habit of open defecation are the common problems especially in urban peripheries.

Keywords: Microbiological water quality analysis, total coliform, fecal coliform, contaminants

Introduction

Ethiopia is one of the member countries that adopted the millennium development declaration with its main objective of poverty reduction (UNDP, 2008). This resulted in prioritizing accessibility to improved water supply. Prior research has revealed that access to clean water, sanitation and hygiene are the significant elements for poverty alleviation (Water Aid, 2009). Access to safe drinking water and sanitation is a global concern. However, developing countries, like Ethiopia, have suffered from a lack of access to safe drinking water from improved

sources and to adequate sanitation services (WHO, 2006). As a result,people are still dependent on unprotected water sources such as rivers, streams, springs and hand dug wells. Since these sources are open, they are highly susceptible to flood and birds, animals and human contamination. In addition, most sources are found near gullies where open field defecation is common and flood-washed wastes affect the quality of water.

According to an ADF (2005) report, the Millennium Development Goals (MDG)objective of Ethiopia is to increase the improved water sources coverage from 2004 levels of 25% water supply and 8% sanitation to 62% for water supply and 54% sanitation by 2015. As a consequence, governmental and nongovernmentalorganizations made efforts to construct improved sources to provide access to safe and potable drinking water. Despite these efforts, improved water sources are often located far from user households, and due to the undulating nature of the country's topography, water sources often occur at inconvenient locations, forcing people to travel long distances over continuous short and long steep slopes. This resulted in more waiting times, inadequate supply, lack of income and lack of quality being the characteristics of many improved schemes (Admasu *et al*., 2002).

These factors lead to less access to water needed by the household for consumption and forced households to seek out alternate unimproved and unhealthy nearby watersources due to reluctance in using improved sources. It is common that people who are most vulnerable to water-borne diseases are those who use polluted drinking water sources. The report from UNICEF (2010), in the world 884 million people use unimproved drinking water sources in 2010, and in 2015 estimates about 672 million people will still using unimproved drinking water sources. The WHO (2000) revealed that seventy five percent of all diseases in developing countries arise from polluted drinking water. The lack of access to water also limits sanitation and hygiene practices in many households because of the priority given for drinking and cooking purposes.

Water quality concerns are often the most important component for measuring access to improved water sources. Acceptable quality shows the safety of drinking water in terms of its physical, chemical and bacteriological parameters (WHO, 2004). Usercommunities" perceptions of quality also carry great weight in their drinking water safety (Doria, 2010). Depending on their perception on taste, odor and appearance(Doria, 2010), this can lead to having different opinions about the aesthetic values of water quality. Consumer perceptions and aesthetic criteria need to be considered when assessing drinking water supplies even though they may not adversely affect human health (WHO, 2004). The main objective of this study is to assess the drinking water quality and determinants of household portable water sources.

1. Water quality parameters

Drinking water, or potable water, is defined as having acceptable quality in terms of its physical, chemical, bacteriological parameters so that it can be safely used for drinking and cooking (WHO, 2004). WHO defines drinking water to be safe if and only if no any significant health risks during its lifespan of the scheme and when it is consumed.

1.1. Perception of drinking water

In terms of drinking water quality, user perception is one of the most important things,sometimes exceeding actual quality of water especially when it concerns the quality of drinking water for the user communities (Doria 2010). There are different factors that influence the perception of drinking water quality, including: Human sensory perceptions of taste, odor and color of water are related with mental factors and some extent taste, which is the more important because it may detect water contamination related to chemicals, People may perceive risks if they experience health problem caused by water, Experience with the previous water source status based on its taste, color and odor change. For example the change in the color of water from yellowish to bluish may feel that the water is perceived not good water (Doria, 2010), Information plays a great role in changing people's perception on the water source behavior. It may be person to person or using media (like news papers, brochures etc.) but in rural areas and poor urban residents interpersonal information is important.

1.2. Bacteriological parameters

The diseases caused by water related microorganisms can be divided into four main categories; **Water-borne diseases**: caused by water that has been contaminated by human, animal or chemical wastes. Examples include cholera, typhoid, meningitis, dysentery, hepatitis and diarrhoea. Diarrhoea is caused by a host of bacterial, viral and parasitic organisms most of which can be spread by contaminated water(WHO, 2006). Poor nutrition resulting from frequent attacks of diarrhoea is the primary cause for stunted growth for millions of children in the developing world (Gadgil, 1998), **Water-related vector diseases**: These are diseases transmitted by vectors, such as mosquitoes that breed or live near water. Examples include malaria, yellow fever, dengue fever and filariasis. Malaria causes over 1 million deaths a year alone (WHO, 2006). Stagnant and poorly managed waters provide the breeding grounds for malaria-carrying mosquitoes, **Water-based diseases**: These are caused by parasitic aquatic organisms referred to as helminths and can be transmitted via skin penetration or contact. Examples include Guinea worm disease, filariasis, paragonimiasis, clonorchiasis andschistosomiasis, **Water-scarce diseases**: These diseases flourish in conditions where freshwater is scarce and sanitation is poor. Examples include trachoma and tuberculosis. Testing the bacterial contaminants in water can be simplified by utilizing the presence of an indicator organism. An indicator organism may not necessarily pose a health risk but it can be easily isolated and enumerated, is present in large numbers, is more resistant to disinfection than pathogens, and does not multiply in water and distribution systems (Gadgil, 1998).

Traditionally, total coliform bacteria have been used to indicate the presence of fecal contamination; however, this parameter has been found to exist and grow in soil and water environments and is therefore considered a poor parameter for measuring the presence of pathogens (Stevens et al., 2003). Studies also show that due to their ability to grow in drinking water distribution systems and their unpredictable presence in water supplies during outbreaks of waterborne disease, the sanitary significance or quality of water is difficult to interpret in the presence of total coliforms (Stevens et al., 2003).

An exception is Escherichia coli (E.coli), a thermotolerant coliform, and the most numerous of the total coliform group found in animal or human feces, rarely grows in the environment and is considered the most specific indicator

of fecal contamination in drinking-water (WHO, 2004). The presence of *E. coli* provides strong evidence of recent fecal contamination (WHO, 2004, Stevens et al., 2003).The risk of coliform presence can depend on the health or sensitivity of the consumer. The risks of E. coli presence, slightly greater than WHO Guideline's zero count per 100ml may be of only low or intermediate risk. According to IRC, 2002 as cited by Michael H., 2006 about risk classification for thermotolerant coliforms or *E. coli* of rural water supplies shown below.

1.3. Chemical parameters

Some of the main chemical parameters that are of a health concern include the following WHO (2004), **Fluoride** causes mottling of teeth and in severe cases can result in crippling skeletal fluorosis, the presence of arsenic implicates the risk of cancer and skin lesions, Nitrate and nitrite can cause methaemoglobinaemia. This arises from excess fertilizers or leaching of wastewater and other organic wastes into water surface, Lead can have adverse neurological effects, mainly in areas with acidic waters and the use of lead pipes, fittings and solder.

Secondary concern of the impact of chemical constituents is the effect on distribution and treatment systems that may be implemented to improve the access to a safe water supply. Corrosive properties of constituents can induce structural failure, which can also result in deterioration of the quality of the water and cause additional concerns for health and safety. Due to these concerns, corrosion control is an important aspect of the management of a drinking water system. pH can control the solubility and reaction rates of most metal species involved in corrosion reactions (WHO, 2004).

Iron, lead, copper, brass and nickel can also be used in construction of piping systems (WHO, 2004). Concrete is a composite material consisting of sand, gravel and cement, a binder consisting primarily of calcium silicates, aluminates and some lime (WHO, 2004). Structural deterioration or failure of cement may result from prolonged exposure to aggressive or highly corrosive waters which can result in leaching of metals from the cement into the water (WHO, 2004).

When ferrous iron oxidizes to ferric iron, it can give a reddish-brown color to the water, which could be aesthetically displeasing (WHO, 2004). Manganese can cause an undesirable taste as well as staining laundry when levels exceed 0.1 mg/liter. The presence of manganese may also lead to the accumulation of deposits in the piping system (WHO, 2004). There is no health-based guideline value set for iron but for manganese it is four times higher than the acceptable threshold of 0.1 mg/liter (WHO, 2004).

1.4. Physical and aesthetic parameters

Consumer perception and acceptability of their drinking water quality depends on user sense of taste, odor and appearance (Sheat 1992; Doria 2010). That is why consumers have differing opinion about the aesthetic values of water quality. Relying on their own senses may lead to avoidance of highly turbid or colored but otherwise safe waters in favor of more aesthetically acceptable but potentially unsafe water sources (WHO, 2004). Taste and odor

can originate from various natural chemical contaminants, biologicalsources, microbial activity, from corrosion or as a result of water treatment (e.g. chlorination) (WHO, 2004). Color, cloudiness, particulate matter and visible organisms can also contribute to unacceptability of water sources. These factors can vary for each community and are dependent on local conditions and characteristics. The following lists a number of primary aesthetic indicators that can cause water to be perceived as unacceptable: True color (the color that remains after any suspended particles are removed); Turbidity (the cloudiness caused by particulate matter present in source water, resuspension of sediment in the distribution system, the presence of inorganicparticulate matter in some groundwater or sloughing of bio-film within the distribution system (WHO, 2004). unusual taste, odor and „feel" problems (usually due to total dissolved solids) Turbidity is the most important problem for the aesthetic value of water quality. Although it doesn't necessarily adversely affect human health, it can protect microorganisms from disinfection effects, can stimulate bacterial growth, and indicate problems with treatment processes (WHO, 2004). For effective disinfection, median turbidity should be below 0.1 NTU although turbidity of less than 5 NTU is usually acceptable to consumers (WHO, 2004). An important operational water quality parameter is pH, although within typical ranges it has no direct impact on consumers.

Low pH levels can enhance corrosive characteristics resulting in contamination of drinking-water and adverse effects on its taste and appearance (WHO, 2004). Higher pH levels can lead to calcium carbonate deposition. Careful consideration of pH is necessary to ensure satisfactory water disinfection with chlorine, which requires pH to be less than 8 (WHO, 2004). Total dissolved solids (TDS) and electrical conductivity (EC) are measures of the total ions in solution and ionic activity of a solution respectively. As TDS and EC increase, the corrosive nature of the water increases.

References

[1] Admasu M., Kumie A. and Fentahun M. (2003). Sustainability of Drinking Water Supply Projects in Rural of North Gondar, Ethiopia, Ethiopian. J. Health Dev. (3):221-229.
[2] African Development Fund (ADF) (2005). Ethiopian rural water supply and sanitation appraisal report. Infrastructure department north, east and south Onin.
[3] Doria M.D.F (2010). Factors influencing public perception of drinking water quality. Water policy 12:1-19.
[4] Gadgil A. (1998). Drinking water in developing countries. Lawrence Berkeley National laboratory, environmental energy technologies division, 1 Cyclotron Road, California, s.1.
[5] Michael H. (2006). Drinking water quality assessment and treatment in east Timor a case study: Tangkae, the University of East Timor. report.
[6] Sheat A. (1992). Public perception of drinking water quality. Should we care? Paper presented at the New Zealand Water Supply and Disposal Association Annual Conference. Cited in Syme& Williams (1993).Slovic, P. (2000). The Perception of Risk. Earthscan, London.
[7] Stevens M., Ashbolt N. and Cunliffe D. (2003). Recommendation to change the use of coli form as microbial indicators of drinking water quality. Australia Government National Health and Medical Research Council
[8] United Nations Children"s Fund (UNICEF) (2010). Progress on sanitation and drinking water. New York: UNICEF.
[9] United Nations Development Program (UNDP) (2008). Millennium development goal
[10] Water Aid (2009). Water, sanitation and hygiene for development.Advocacy for change.
[11] World Health Organization (2006). In Water, Sanitation and Health World Health Organization.

[12] World Health Organization (2000). Disinfectants and disinfectant by products.(Environmental health criteria 216). Geneva: world health organization.

[13] World Health Organization (2004). Guidelines for Drinking-water Quality, World Health Organization, Geneva.

[14] World Health Organization (2006). In Water, Sanitation and Health World Health Organization.