

Assessment of Consumer Perceptions on Factors Affecting Drinking Water Quality from Water Vendors in Nalerigu in the North East Region of Ghana

Mahama Bashiru¹; Justin Yendoh J²; Jerry John Amaasende Akooti³; Abubakari Yakubu⁴

^{1,2,3,4}Department of Water and Sanitation, College of Nursing and Midwifery, Post Office Box 10, Nalerigu-NE/R, Ghana

Zulkifuru Aliu-Musah⁵

⁵Department of Nursing, College of Nursing and Midwifery, Post Office Box 10, Nalerigu-NE/R, Ghana

Corresponding Author:- Mahama Bashiru¹

Abstract:- Safe drinking water is a major concern in most developing countries in the world. Consumer's perspectives of safe drinking water quality is attributed to characteristics such as odour, appearance and taste. The study assessed consumer's perceptions on factors affecting drinking water quality from water vendors in Nalerigu, in the North East Region of Ghana. A quantitative cross-section design was used for the study. Sampling was done using a systematic random sampling technique to select 222 households out of 500 for the study. Data was analyzed using Statistical Package for Social Science (SPSS version 2020). Majority of the respondents were males (63%) and others were females (37%). The study revealed the perceived sources of pollution for drinking water in the area were agriculture and water handling activities (64.1% and 35.9%). Findings further revealed; sources of water supply contained constituents (56.4%), taste (7.7%) and odour (40.4%) respectively. The study also revealed households buy water from various vendor services such as; the tricycles (61.9%), donkey cart (29.8%) and water tanker services (8.3%). The inadequacy of public water utility services could be a factor for household high patronage of vended water services in the area. Also, the use of chemicals in agricultural activities and vendors activities such as; use of old aluminum drums in supply of drinking water may be a potential source for water pollution in the area. The study findings will be useful to stakeholders and MMDA's for adequate decision making regarding water in the area. It will further assist policymakers in policy formulation on best practices to safeguard drinking water.

Keywords:- Water Quality, Pollution, Drinking Water, Vendors and Attributes.

I. INTRODUCTION

Consumer's perceptions about drinking water quality mostly influence its use in many instances. In the past, many populations believed that good drinking water should be free

from constituents such as; taste, colour, odour and other impurities (Water and Sanitation Programme & UNICEF, 2015; WHO & Unicef, 2013). Globally, over one billion people depend on water systems that are contaminated with feces from humans and other animals and poor in quality (Bain et al., 2014; Wright et al., 2004). Increase in human population, urbanization, industrialization, use of agrochemicals (e.g. pesticides and fertilizers) for farming activities and human activities have influenced the quality of water in many cases (Akumiah & Universitet, 2007; Awepuga, 2015). The choice of whether to use an improved water source over an unimproved water source for household activities is a responsibility of the government (Kosinski et al., 2016). Nevertheless there is limited supply and inadequate coverage of water supply systems in most urban and rural areas due to increase in human population and this therefore calls for alternative ways of water supply and distribution. The informal water vendor is suggested as one alternative means for water supply and has gained much attention in public distribution of water to households (McGrathan et al., 2006). Studies have indicated that; many factors influence household water decision-making process and they include knowledge of water treatment, perceptions on the quality of water and socio-demographic characteristics (Delina & Dasinaa, 2016; Mohsin et al., 2013). The consumers' perspectives on drinking water quality are through common observations of its colour and taste without necessarily considering the physical, chemical and microbial characteristics that guarantee water a good quality (Lee, 2017). These factors considered by consumers regarding the quality of drinking water such as taste, odour, and colour can influence users' decision, satisfaction, and willingness to choose between water sources (De França Doria, 2010). Some of these characteristics could result in long-term public health hazards. Water which has changed in its appearance and taste, as well as water that smells bad, may be considered by consumers to be unsafe (World Health Organisation (WHO), 2008; World Health Organization, 2014). Although many research studies have been done in other jurisdictions to investigate the quality of drinking water from water vendors, no similar studies have

been conducted in this area. The integration of perspectives from consumers can be challenging and threat for water professionals in the implementation of water use policies, but ignoring such perspectives can lead to public dissatisfaction and implementation challenge (Araral, 2010). It is undeniable that, a better understanding of the processes associated with public perceptions on water quality is vital. This will provide information for stakeholders to work towards the improvement of water quality and adequate decision making regarding the provision of safe water to meet consumer needs. Therefore, assessing consumers' perceptions on factors affecting drinking water quality from the water vendor in Nalerigu is essential for public health benefits.

II. METHODS AND MATERIALS

➤ *Study Area*

The study was conducted in Nalerigu, the capital town of the North East Region. Majority (85%) of the people are involved in agriculture and traders and others representing 11%. About (96.0%) of the population are self-employed (Ghana Statistical Service & Ghana Demographic Health Survey, 2008). A few people in the area are employed in the public sector: government (2%), private formal (1%) and NGOs at local and international (1%). The main sources of water for the inhabitants' are; borehole and tube well (33.6%) and rivers and streams (28.8%). Pipe-borne water is also used by a relatively high proportion of urban households (30.1%) compared to rural households (1.1%) (East Mamprusi, 2020). Most households depend on open wells and rivers for drinking water, also they rely on the informal water provider services for water for most domestic activities. Factors that influence water supply and quality in the area include; population growth, rapid urbanization, and farming activities etc. Other factors which may cause the pollution of water sources may include; open defecation, use of pesticides and fertilizer, and bush burning etc. They augment water use through informal vendor service providers such as; tanker trucks, tricycles, and donkey carts.

➤ *Study Design*

The study employed a quantitative cross-sectional design (use of questionnaires and interviews).

• *Sampling and Sample Size Calculation*

A systematic random sampling technique was used to choose respondents for the study to seek their perception on factors affecting the quality of drinking water from informal water vendors. The study used systematic random sampling because it allowed for the inclusion of households that relied on vended water for the study. A sample of 222 households

was chosen out of 500 households to investigate consumers' perception on factors affecting the quality of drinking water.

The sample size was computed considering the following equation (Shalabh, 2006).

$$n = \frac{N}{1 + Ne^2}$$

Where; n=the computed sample size (households), N=500 (total number of households)

e=acceptable amount of error (0.05) and

Sample interval=Total number of basic sampling units (households) in population ÷ Number of sampling units needed for the sample

Households=500

Sample (n) =219

Sample interval=500/222=2

➤ *Data Collection*

The data collection techniques employed for the study were survey and water sampling techniques. Questionnaires were used to gather data on consumers' perceptions on factors affecting drinking water quality supplied by the informal water vendor. Closed-ended questions were used and participants were interviewed face to face. A response rate of 82.6% was obtained for the household questionnaire.

➤ *Data Analysis*

Data was analyzed using Statistical Package for Social Science (SPSS version 2020). Questionnaires for the survey were sorted and coded into the SPSS. Findings were presented in tables indicating frequencies and percentages.

III. RESULTS AND DISCUSSIONS

➤ *Socio-Demography of Respondents*

Socio-demographic characteristics of the study respondents' revealed majority were males (63%) and the others were females (37%). Most respondents (53%) were between 40-50 years, others (23.8%) were between 51-61 years and a few others (19.3%) were between 29-39 years as indicated in Table 1. The differences in gender, age, and responsibilities of the individuals influence household water access and use (Awepuga, 2015). Regarding household size, most respondents (42.5%) had a household size of 6-10 with others >10 (34.8%) and household size of 1-5 (22.7%). A good number of the study respondents (49%) were farmers with some being traders (22.1%), self-employed (21.5%) and government employees (6.1%). (22.1%), self-employed (21.5%) and government employees (6.1%). Socio-demographic characteristics may influence people's perceptions in several ways such as the need to assess water and adequate decision making towards the use of water (Mumbi & Watanabe, 2020).

Table 1 Socio-Demographic Background of Study Respondents

Variables	Frequency (n=181)	Percentage (%)
Gender		
Male	114	63
Female	67	37
Age		
18-28	7	3.9

29-39	35	19.3
40-50	96	53
51-61	42	23.8
Occupation		
Trading	40	22.1
Self-employed	39	21.5
Farming	90	49.7
Government employed	12	6.6
Household size		
1-5	41	22.7
6-10	77	42.5
>10	63	38.8

➤ *Households' Perception on Water Quality from the Informal Water Vendors*

The study examined consumers' perceptions of the source water, vended supplied water and the vendors' type households patronize water for domestic activities. Finding revealed that; most of the respondents indicated the source of water supply contained impurities (56.4%). Some (31.5%) indicated the source of water was clean while others maintained the source of water supply for household activities has taste (7.7%) and odour (40.4%) in Table 2.

Identifying consumers' perspectives and judgment of the characteristics of their drinking water is essential in ensuring the safe management and provision of solutions to drinking water and its associated problems (Mumbi & Watanabe, 2020). Respondents' views on whether they trusted the quality of vended water indicated majority (88.4%) trusted the quality informal vended water; while a few others (11.6%) do not trust the quality of vended water as a healthy source indicated in Table 2:.

Table 2 Perceived Factors Affecting Water Supply for Households

Variables	Frequency (n=181)	Percentage (%)
Perceived impression about water source		
It contain impurities	102	56.4
It has odour	55	40.4
It has taste	14	7.7

➤ *Households Sources of Vended Water.*

Figure 1 presents respondents' choice of vended water for households' activities. The study revealed most of the study respondents buy water from the tricycle (61.9%), some respondents also buy water from the donkey cart (29.8%) and water tanker services (8.3%). The majority

(61.9%) that buy water from the tricycle vendor services stressed on the easy access to tricycles and the low cost in the supply of water. The inadequacy of municipal water utility services in the area could as well be another factor for household patronage of informal vended water services in the area.

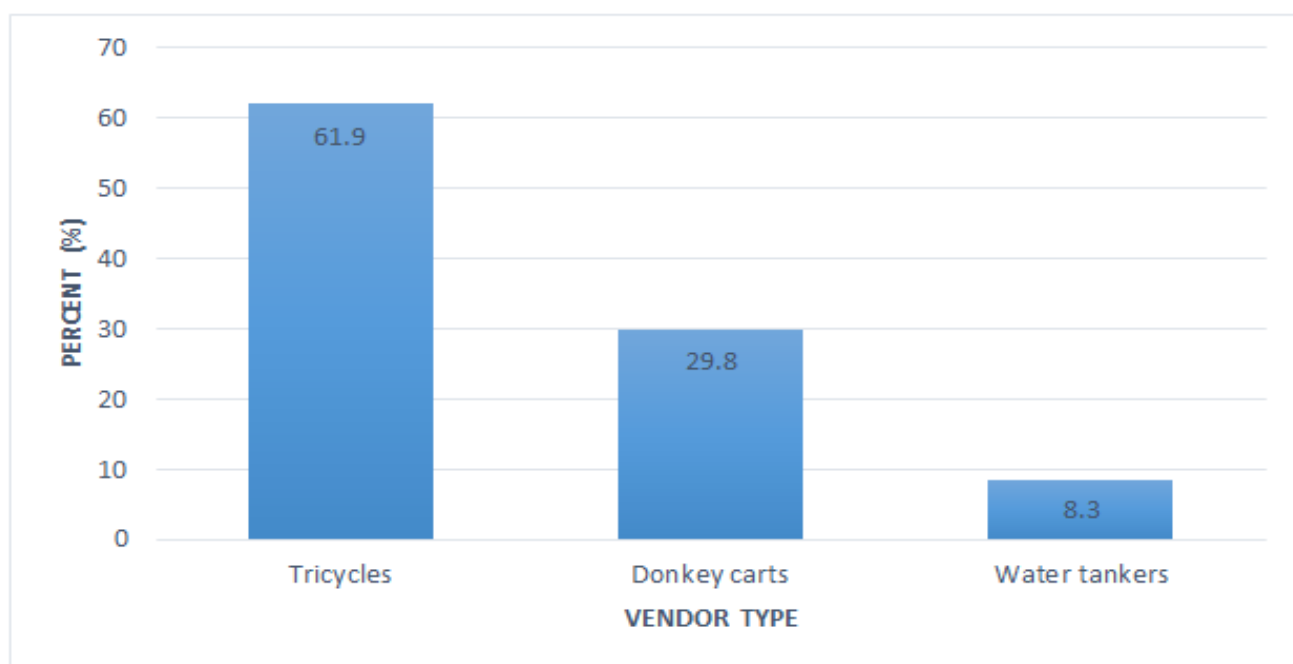


Fig 1 Households Sources of Vended Water

➤ *The Perception about Vended Water and the Source of Pollution*

Table 3 presents respondents' perceptions about vended water and the source of pollution. The study respondents revealed the sources of pollution for drinking water in the area as agriculture and water handling activities (64.1% and 35.9%). Most respondent concluded that; containers and receptacles used by vendors and in households may influence the quality of water and may be detrimental to consumers' health. This is agreed by a study that indicated most participants had the view vended water was unsafe and unhygienic and may be of public health interest (Olajuyigbe et al., 2012). Respondents' satisfactory level on the quality of vended water revealed that, 44.2% of the respondents were satisfied, and 31.5% were fairly satisfied. The respondents may view vendors' source as a necessary coping strategy in the supply of water for households even though quality of water may be an issue. A few others (24.3%) said they were not satisfied in terms of the quality

of water in the area and may consider this as a social neglect. The frequency of water supply by water vendors revealed majority (51.4%) of the study respondents do not get water more often. Some respondents (47%) said they get water most often from the vendors services for domestic activities, with a few others being indifferent (1.7%). Nonetheless, the willingness to pay for water supply and utility services is essential and should be seen as a means for accessible and adequate provision and supply of water; the study assessed the willingness of consumers to pay for water utility if water connections were extended to households. It was revealed that; most respondents (76.2%) showed the willingness to pay, while a few others (18.2%) indicated it was the responsibility of the government, with others (5.5%) indicating they were not willing to pay. The majority that showed their willingness to pay indicated water is life and should be made available at all cost. They reiterated that, pipe water connections will help reduce water-related diseases and wastage of time in search for water.

Table 3 Households' Perception of Water Quality from the Informal Water Vendors

Variables	Frequency (n-181)	Percentage (%)
Do you buy vended water		
Yes	170	93.9
No	11	6.1
Perceived pollution source of drinking water		
Agricultural activities	116	64.1
Poor handling by vendors	65	35.9
Are you satisfied with your water		
Satisfied	80	44.2
Fairly satisfied	57	31.5
Not satisfied	44	24.3
Frequency of getting water		
Often	85	47
Not often	93	51.4
Do not know	3	1.7
Willingness to pay for water		
Willing to pay	138	76.2
Government responsibility	33	18.2
Not willing	10	5.5

➤ *Knowledge and Awareness on Risks Associated with Drinking Water*

Water is considered safe when it does not contain pathogens or harmful substances such as chemical substances, and it should be free from colour, odour, and usable for domestic activities (Dinka, 2018). There have been studies on the epidemiological reality for the safety of drinking water in many instances (Cairncross et al., 2010; Waddington et al., 2009). Against this backdrop, the study assessed respondents' knowledge and awareness of the risks associated with drinking water as provided in Table 4. Findings revealed that, most (86.7%) respondents were aware of the problems of unsafe water. While others (13.3%) were unaware of the implications of consuming unsafe water. Water sources that include; households pipe networks, municipal stand pipe, borehole, hand-dug well, and others should be safe and accessible (WHO, 2013; WHO and UNICEF, 2017; Pal et al., 2018). Water treatment is important in the bid to eliminate water-related diseases,

most especially when households consume water from raw water sources. The study assessed respondents' means of treating household drinking water. Most respondents (81.8%) revealed they use chlorine pellets to treat household water before consumption, others (18.2%) said they do not treat their drinking water by any other means before use. The majority of the respondents who treat their water with chlorine pellets may be well aware of the risks involved in consuming contaminated water. The study revealed the reasons for households' treatment of household drinking water as; to kill microorganisms (58%), while some others indicated the removal of odour (21%), improvement of taste (5.5%) and 15.5% were indifferent. Consuming polluted water has not only resulted in many public health threats, but also cause diseases (Bressler & Hennessy, 2018; Nabi et al., 2019; Pal et al., 2018). In line with this, respondents were asked whether poor water quality contributes to diseases, which majority (97.8%) indicated it contributes to diseases while few others (2.2%) were indifferent.

Contaminated water is unsafe for public consumption and therefore places consumers at risk of getting sicknesses such as typhoid, diarrhea and other waterborne diseases (Hughes & Koplan, 2005). A previous study revealed that, consumption of contaminated drinking water could result in infections which may consequently cause childhood diarrhea, a major cause of child death in most developed nations (Diouf et al., 2014; Rufener et al., 2010). Most respondents for the study indicated typhoid fever and diarrhea were linked to the ingestion of unsafe water (37.6%

and 38.1%). This means that respondents may have knowledge of the consequence of consuming water from contaminated sources and hence may employ the necessary remedies to keep the water clean. Most respondents indicated diarrhea (37.6%) and typhoid (38.1%) were some of the diseases associated with unsafe water. Water contamination can cause a gross setback in the development of a nation through diseases and illness (Mohsin et al., 2013).

Table 4 Knowledge and Awareness on the Risk Associated with Drinking Water

Variables	Frequency (n=181)	Percentage (%)
Are you aware of the risk associated with drinking water		
Yes	157	86.7
No	24	13.3
Do you treat household water with chlorine pellets		
Yes	148	81.8
No	33	18.2
Reasons for treatment of household water		
To kill bacteria	105	58
To remove odour	38	21
To improve taste	10	5.5
Do not know	28	15.5
Do poor water quality contribute to diseases		
Yes	177	97.8
No	4	2.2
Type of diseases associated with water		
Typhoid	69	38.1
Diarrhea	68	37.6
Cholera	44	24.3

➤ *Water Storage and Cleaning of Storage Containers*

Table 5 indicates respondents’ storage practices of drinking water for households’ activities. The study revealed that, majority of the respondents (58%) stored their drinking water in plastic drum/metal drums with lids. In addition, some respondents (28.2%) stored their drinking water in clay pots and a few others use jerry cans (5%) and open basins (2.2%). The majority that used plastic drum/metal drums with lids could be well aware of hygiene practices

and public health benefits and may adopt measures to ensure the provision of safe water. Those that store their water in open basins could expose their drinking water to contaminants, which may be detrimental to health. The methods used for the storage of water at home could result in contamination and its negative implication to the consumer. This is evidenced by previous research work that was conducted in certain parts of Sierra Leone, South Africa, and Zimbabwe (Trevett et al., 2005).

Table 5 Storage and Cleaning of Water Storage Containers

Variables	Frequency (n=181)	Percentage (%)
How do you store your water		
Poly tank	12	6.6
Clay pots	51	28.2
Jerry-cans	9	5.0
Open basins	4	2.2
Metal/plastic drums	105	58
How often do you wash your storage container		
1-5 days	164	90.6
6-10 days	17	9.4

IV. CONCLUSION

The study findings revealed that; the source of water supply contained impurities (56.4%), taste (7.7%) and odour (40.4%) respectively. The study further revealed households buy water from vendor services such as; the tricycles

(61.9%), donkey cart (29.8%) and water tanker services (8.3%). This contamination may be due to agricultural and water handling activities in the area. In view of this, regular monitoring, regulation and provision of water supply systems at the area is therefore emphasized. Human activities such as open defecation, farming, and improper

water handling by informal water vendors during transportation and distribution are most likely the reasons for contamination. The findings of the study will provide the East Mamprusi Municipal Assembly and other stakeholders with the necessary information for adequate decision making.

➤ *Conflict of Interest*

The authors declare that there is no conflict of interest

REFERENCES

- [1]. Akumiah, P. O., & Universitet, L. (2007). Water management and health in Ghana; Case study - Kumasi Master of science Thesis, Environmental Science Programme 2007, Supervisor: Science.
- [2]. Araral, E. (2010). Improving effectiveness and efficiency in the water sector: Institutions, infrastructure and indicators. *Water Policy*, 12(SUPPL. 1), 1–7. <https://doi.org/10.2166/wp.2009.051>
- [3]. Awepuga, A. (2015). *Water Scarcity in the Tamale Metropolis and the Role of the Informal Water Sector in Urban Water Supply*. 153.
- [4]. Bain, R., Cronk, R., Wright, J., Yang, H., Slaymaker, T., & Bartram, J. (2014). Fecal Contamination of Drinking-Water in Low- and Middle-Income Countries: A Systematic Review and Meta-Analysis. *PLoS Medicine*. <https://doi.org/10.1371/journal.pmed.1001644>
- [5]. Bressler, J. M., & Hennessy, T. W. (2018). Results of an Arctic Council survey on water and sanitation services in the Arctic. *International Journal of Circumpolar Health*, 77(1). <https://doi.org/10.1080/22423982.2017.1421368>
- [6]. Cairncross, S., Hunt, C., Boisson, S., Bostoen, K., Curtis, V., Fung, I. C. H., & Schmidt, W. P. (2010). Water, sanitation and hygiene for the prevention of diarrhoea. *International Journal of Epidemiology*. <https://doi.org/10.1093/ije/dyq035>
- [7]. De França Doria, M. (2010). Factors influencing public perception of drinking water quality. *Water Policy*. <https://doi.org/10.2166/wp.2009.051>
- [8]. Delina, P. J. E., & Dasinaa, S. I. (2016). Consumer Perception and Factors Influencing in Adapting of Bottled Water Consumption in Batticaloa District, Sri Lanka. *International Journal of Interdisciplinary Research Methods*, 3(4), 1–13. www.eajournals.org
- [9]. Dinka, M. O. (2018). Safe Drinking Water: Concepts, Benefits, Principles and Standards. *Water Challenges of an Urbanizing World*. <https://doi.org/10.5772/intechopen.71352>
- [10]. Diouf, K., Tabatabai, P., Rudolph, J., & Marx, M. (2014). Diarrhoea prevalence in children under five years of age in rural Burundi: An assessment of social and behavioural factors at the household level. *Global Health Action*, 7(1). <https://doi.org/10.3402/gha.v7.24895>
- [11]. Hughes, J. M., & Koplan, J. P. (2005). Saving lives through global safe water. *Emerging Infectious Diseases*, 11(10), 1636–1637. <https://doi.org/10.3201/eid1110.051099>
- [12]. Kosinski, K. C., Kulinkina, A. V., Abrah, A. F. A., Adjei, M. N., Breen, K. M., Chaudhry, H. M., Nevin, P. E., Warner, S. H., & Tendulkar, S. A. (2016). A mixed-methods approach to understanding water use and water infrastructure in a schistosomiasis-endemic community: Case study of Asamama, Ghana. *BMC Public Health*, 16(1), 1–10. <https://doi.org/10.1186/s12889-016-2976-2>
- [13]. Lee, L.-H. (2017). Appearance's Aesthetic Appreciation to Inform Water Quality Management of Waterscapes. *Journal of Water Resource and Protection*, 09(13), 1645–1659. <https://doi.org/10.4236/jwarp.2017.913103>
- [14]. McGranahan, G., Water, E., Albu, M., Smith, M. D., & Mitlin, D. (2006). *How small water enterprises can contribute to the millennium development goals: evidence from Dar es Salaam, Nairobi, Khartoum and Accra*. 47. <https://dspace.lboro.ac.uk/dspace-jspui/handle/2134/12703>
- [15]. Mohsin, M., Safdar, S., Asghar, F., & Jamal, F. (2013). Assessment of drinking water quality and its impact on residents health in Bahawalpur City. *International Journal of Humanities and Social Science*.
- [16]. Mumbi, A. W., & Watanabe, T. (2020). Differences in risk perception of water quality and its influencing factors between lay people and factory workers for water management in River Sosiani, Eldoret Municipality Kenya. *Water (Switzerland)*, 12(8), 1–25. <https://doi.org/10.3390/w12082248>
- [17]. Nabi, G., Ali, M., Khan, S., & Kumar, S. (2019). The crisis of water shortage and pollution in Pakistan: risk to public health, biodiversity, and ecosystem. *Environmental Science and Pollution Research*, 26(11), 10443–10445. <https://doi.org/10.1007/s11356-019-04483-w>
- [18]. Olajuyigbe, A. E., Rotowa, O. O., & Adewumi, I. J. (2012). Water vending in Nigeria - A case study of Festac Town, Lagos, Nigeria. *Mediterranean Journal of Social Sciences*, 3(1), 229–239. <https://doi.org/10.5901/mjss.2012.03.01.229>
- [19]. Pal, M., Ayele, Y., Hadush, A., Panigrahi, S., & Jadhav, V. J. (2018). Public Health Hazards Due to Unsafe Drinking Water. *Air & Water Borne Diseases*, 7(June), 1–6. <https://doi.org/10.4172/2167-7719.1000138>
- [20]. Rufener, S., Mäusezahl, D., Mosler, H. J., & Weingartner, R. (2010). Quality of drinking-water at source and point-of consumption-Drinking cup as a high potential recontamination risk: A field study in Bolivia. *Journal of Health, Population and Nutrition*, 28(1), 34–41. <https://doi.org/10.3329/jhpn.v28i1.4521>

- [21]. Shalabh. (2006). *MTH 417: Sampling Theory. Chapter 11 Systematic Sampling Systematic sampling.* 1–17. <http://home.iitk.ac.in/~shalab/sampling/chapter11-sampling-systematic-sampling.pdf>
- [22]. Trevett, A. F., Carter, R. C., & Tyrrel, S. F. (2005). The importance of domestic water quality management in the context of faecal-oral disease transmission. *Journal of Water and Health.* <https://doi.org/10.2166/wh.2005.037>
- [23]. Waddington, H., Snilstveit, B., White, H., & Fewtrell, L. (2009). Water, Sanitation and Hygiene Interventions to Combat Childhood Diarrhoea in Developing Countries. *3ie Synthetic Reviews.*
- [24]. Water and Sanitation Programme, & UNICEF. (2015). Water Supply and Sanitation in Ghana: Turning Finance into Services for 2015 and Beyond. *World Bank.*
- [25]. WHO and UNICEF. (2017). Progress on Drinking Water, Sanitation and Hygiene: 2017 Update and SDG Baseline. In *World Health Organization.* <https://doi.org/10.1016/j.pnpbp.2017.06.016>
- [26]. WHO, & Unicef. (2013). Progress on Sanitation and Drinking Water 2013 Update. *World Health.* https://doi.org/http://apps.who.int/iris/bitstream/10665/81245/1/9789241505390_eng.pdf?ua=1
- [27]. World Health Organisation (WHO). (2008). WHO guidelines for drinking-water quality - Third edition. *WHO Press, Geneva.*
- [28]. World Health Organization. (2014). Guidelines for Drinking-Water Quality: Fourth Edition Incorporating the First Addendum. In *Guidelines for Drinking-Water Quality: Fourth Edition Incorporating the First Addendum.*
- [29]. Wright, J., Gundry, S., & Conroy, R. (2004). Household drinking water in developing countries: A systematic review of microbiological contamination between source and point-of-use. In *Tropical Medicine and International Health.* <https://doi.org/10.1046/j.1365-3156.2003.01160.x>