

A Preview of Water, Sanitation and Hygiene Practices in Kofai Community of Taraba State, Nigeria

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Abstract: Water, including sources and types of treatment, sanitation and hygiene practices affect human health. The prevention, control and protection against outbreaks of water related diseases is crucial. The study assessed water, sanitation and hygiene related conditions and practices of the households in Kofai community to determine appropriate public health interventions for the community. A cross sectional descriptive study was carried out using 372 individual households selected using multistage random sampling method after due consents and ethical processes. The analysis of data was done using the SPSS software version 20.0 and Microsoft Excel 2010. The result showed that 204 (54.8%) participants were females; 267 (71.8%) were married; the mean age was 33.6±11.9 and farming formed approximately 31.2% of all occupational categories amongst the respondents. The sources of water supply was mainly through vendors 130 (34.9%), followed by borehole 92 (24.7%), well 71 (19.1%) and rain water 36 (9.7%). Type of treatment for drinking water included boiling (18.5%), filtration with cloth (16.1%), use of chlorine tablet (5.7%) and no form of treatment at all (59.7%). Only 84 (22.6%) had facility for hand washing. Domestic waste disposal practices include open dumping (73%), burning (18%), and refuse pit (9%). Sewage disposal practices were open defecation (36%), while 64% were using latrines. Of all latrines, 42.4% were pit latrines, 39.0% were pour flush, and 18.6% were cistern flush. Water, sanitation and hygiene practices and infrastructure in Kofai are in mid-stage development. More of modern water supply in form of boreholes and pipe-borne water are needed, as well as sanitary disposal of domestic waste and sewage. Provision of more latrines will drastically reduce the open defecation practice seen in more than a third of the community. Deploying appropriate triggering intervention through sustained community led total sanitation has a potential of transforming the community to an open defecation free status towards Nigeria's target of 2025.

Keywords: Water, Sanitation, Latrine, Open Defecation, Taraba, Nigeria

1. Introduction

A key focus of Environmental Public Health in disease prevention and control is on water, sanitation and hygiene practices [1]. In recent times, lack of access to potable water, sanitation and hygiene (WASH) and their impacts on health and well-being have become a major concern. Globally, 663 million people lack access to an improved water source [2], and an estimated 2.4 billion people (more than 35% of world's population) had no access to improved sanitation facilities [3]. Comparatively, the situation is worse for sub-Saharan Africa

(sSA) which has the lowest levels of access to both potable water and sanitation. In sSA, it is estimated that 102 million people still use surface water, and 695 million people still use unimproved sanitation facilities [4]. In Nigeria, an estimated 100 million people lack basic sanitation facilities, with 62 million people having no access to safe drinking water [5].

Very recently, official Country Report on Nigeria by the Federal Ministry of Water Resources, (FMWR) revealed an alarming high rate of open defecation across the country (national average, 37%), with Taraba State at 52.5% [6]. This rate, of course, is expected to be higher in specific rural communities such as Kofai. What hazards and risks do such a

situation pose?

Inadequate sanitation is estimated to cause 280,000 diarrheal deaths annually, and is a major factor in several neglected tropical diseases [7]. Globally, diarrhoea is a leading cause of child mortality [8], and is thought to be a determinant cause of childhood malnutrition [9]. In Nigeria, it was reported that about 122,000 persons including 87,000 under-five children die each year from diarrhoea with 90% directly attributed to water, sanitation and hygiene [10]. But the greatest risk attending such ugly situation is heightened vulnerability to classical epidemic outbreak such as cholera.

The morbidity, mortality and other socio-economic losses arising from lack of access to WASH have rekindled a concern among Governments, responsible institutions, communities and individual actors to take all necessary actions to improve on existing WASH situations and forestall any possible outbreak of epidemic. According to the WHO:

“The provision of safe water, sanitation, and hygienic conditions is essential for protecting human health during all infectious disease outbreaks, including the coronavirus disease 2019 (COVID-19). Ensuring evidenced-based and consistently applied WASH and waste management practices in communities, homes, schools, marketplaces, and health-care facilities will help prevent human-to-human transmission of, the virus that causes COVID-19” [11].

This study aligns with this prevailing concern, especially, considering the proximity and intimate interaction between Kofai community and the Taraba State University (TSU) community. Accordingly, this study seeks to ascertain WASH related conditions and practices in Kofai community as a prelude to the determination of appropriate remedial interventions. It is a pioneering research that will provide the sub-structure for future knowledge super-structure and evidence-led intervention.

2. Methods

2.1. Study Area

The study was carried out in Kofai, a rural community located in Ador-Kola Local Government Area (LGA) in Taraba State, North-East Nigeria. It is a moderate-sized settlement with household population of 5,386 [12]. Taraba State University (TSU), established in 2007, is located at the outskirts of Kofai territory. The Faculty of Health Sciences of TSU was established in 2017. Therefore, Kofai, being a host community to a young University with a new Faculty of Health Sciences will, inevitably, be a proximal ground for health science research.

2.1.1. Study Design

This is a cross-sectional descriptive study conducted in Kofai which offered precise description and information on water, sanitation and hygiene practices.

2.1.2. Study Period

The study period spanned from 12th July, 2018 – 15th

September, 2018.

2.2. Participants and Sampling

Total study population was 5,386 households. Respondents were 18 years of age and above, able to speak and understand English Language and/or the local dialects. All respondents live in house units included in the study. The sample size used was 372, which was determined using Sloven's formula [13] $n = \frac{N}{1 + Ne^2}$. Where: n=sample size, N=total population of the study (5,386), e=the error of sampling (5% or 0.05), 1=constant. A community based cross-sectional interview was administered to respondents in randomly selected households in Kofai using multistage sampling method. The community was partitioned into seven sections to ensure equitable area distribution. In each area-section, 53 households were selected using systematic random sampling at a sampling interval of 14 (5386/372). Every 14th household was entered starting from the first household at one end of the street randomly selected, on both sides, until the end of that street. At this point the researchers turned and continued sampling till the selected sections were sampled and the estimated sample size achieved. Within a household, an eligible respondent was identified and then interviewed.

2.3. Questionnaire and Interview Procedure

A pre-tested, structured, interviewer-administered questionnaire was used to collect primary data from members of households on WASH practices in Kofai community. Village Health Workers and local council leaders assisted to facilitate a seamless interface with respondents. The research questions were read out and interpreted (where applicable) to the respondents to make sure all sections are filled. Responses were recorded and ticked in the questionnaire. WASH practices were assessed using basic information on provision of latrine/toilet in the household, type of toilet facility provided, hygienic condition of the latrine/toilet facility, presence of handwashing facility, method of water treatment, sources of drinking water and methods of domestic solid waste disposal. The questions included single type responses where the respondent selects from among two or multiple options.

2.4. Data Analysis and Presentation

The data collected were processed and analyzed using SPSS software version 20.0 (IBM-SPSS Corporation, Chicago, III, USA) and Microsoft Excel 2010. Results were presented in the form of frequency table and figures.

2.5. Ethical Consideration

The Department of Public Health, Taraba State University, Jalingo approved the study protocol. Respondents were informed of study objectives, consent procedures and potential benefits. They were also informed of their liberty to accept or decline participation or withdraw at any time without fear of any retribution. Those eligible gave informed

verbal consent and were enrolled in this study. The use of study identification numbers for respondents was adopted to ensure anonymity and confidentiality in the data collection process.

3. Result

3.1. Respondents' Characteristics

The demographic statistics of the respondents is presented below. A total of 372 respondents participated in this study which included 204 females (54.0%) and 168 males (46.0%). The mean age was 33.6 ± 11.9 , with a range of 18 – 70 years. Quite a number of the respondents (300,, 80.9%) were married. Respondents with secondary education were 38.2% and farming formed approximately 31.2% of all occupation categories amongst the respondents (Table 1).

Table 1. Socio Demographic Characteristics of the Respondents (n=372).

Respondent characteristics	Number (%)
Gender	
Male	168 (45.2)
Female	204 (54.8)
Age (Years)	
18 – 25	106 (28.5)
26 – 35	138 (37.1)
36 – 45	55 (14.8)
46 – 55	51 (13.7)
56 and above	22 (5.9)
Mean Age= 33.6 ± 11.9	
Marital Status	
Single	81 (21.7)
Married	267 (71.8)
Divorced	8 (2.2)
Widow	16 (4.2)
Highest Educational Level	
None	50 (13.4)
Primary	124 (33.3)
Secondary	142 (38.2)
Tertiary	56 (15.1)
Occupation	
Civil Servant	68 (18.3)
Farming	116 (31.2)
Trading	115 (30.9)
Housewife	10 (2.7)
Student	48 (12.9)
Others	15 (4.0)
Number of Children	
None	68 (18.3)
1-2	94 (25.3)
3-4	112 (30.1)
5 and above	98 (26.3)
Religion	
Christian	360 (87.1)
Muslim	46 (12.4)
Others	2 (0.5)

3.2. WASH Practices

3.2.1. Latrine Facilities

Most of the respondents, 236 (64%), had latrines in their household (Figure 1). Figure 2 shows that out of the 236 (64%) of the respondents who recorded presence of latrine/toilet

facility in the household, 100 (42.4%) had access to pit latrine with slabs/platforms, 92 (39.0%) had access to pour flush while 44 (18.6%) to septic tank. Figure 3 presents the condition of the latrines in the households. Majority (150; 40.3%) of the latrine/toilet facilities were in a moderate hygienic condition, (64; 17.2%) maintained good hygienic condition; while (138; 33.1%) were in bad/deplorable hygienic condition.

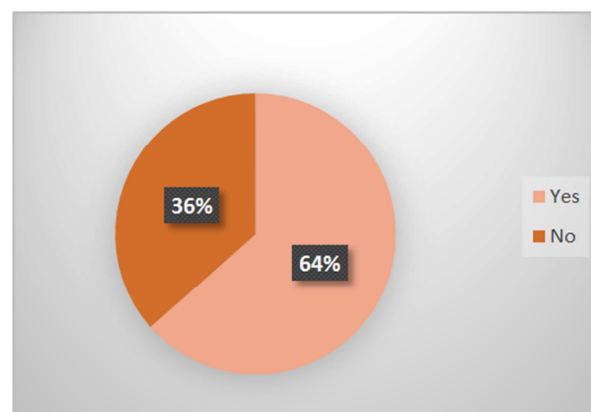


Figure 1. Provision of Latrines by Households.

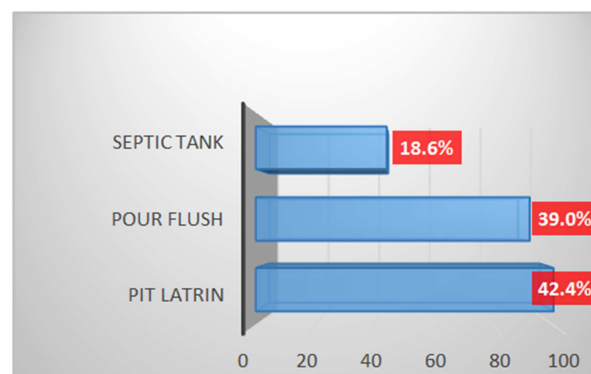


Figure 2. Types of Latrine Facility Provided in Households (n=236).



Figure 3. Hygienic Condition of Latrine.

3.2.2. Water Conditions

Majority (288; 77.4%) of the households do not have hand washing facility while 84 (22.6%) have (Figure 4).

Figure 5 presents the source of drinking water. The major source of household drinking water was procurement from water vendors (130: 34.9%); boreholes (92: 24%), and wells (52: 19.1%). In Figure 6, 222 (59.7%) of the respondents were not using any method of water treatment; 69 (17.8%) used boiling method; while 60 (15.5%) filter with cloth.

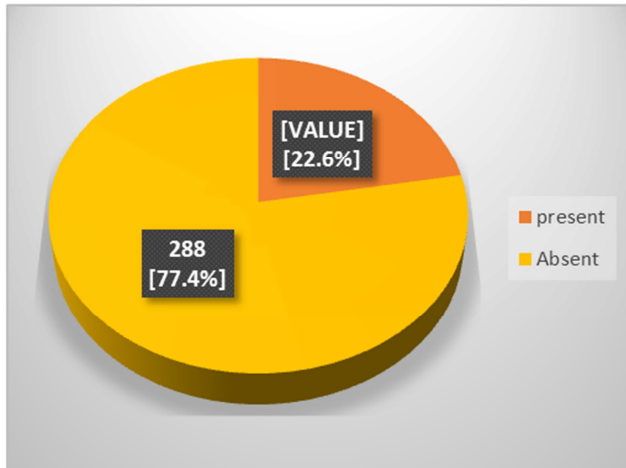


Figure 4. Presence of Hand Washing Facility.

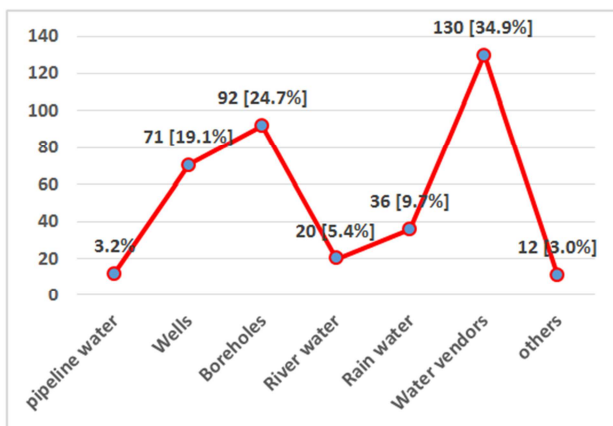


Figure 5. Sources of Drinking Water.

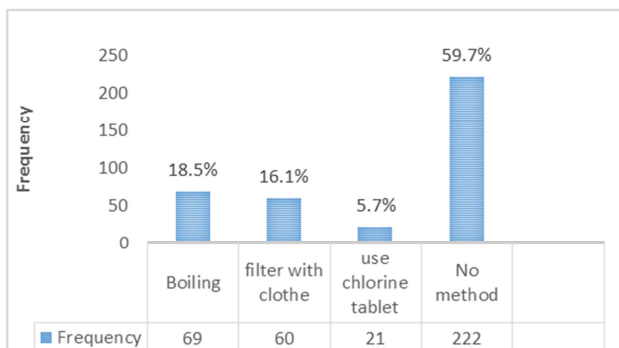


Figure 6. Water Treatment Methods in Use.

3.2.3. Domestic Solid Waste Disposal Practices

Figure 7 shows that 271 (73%) of the respondents discharged their solid waste in open area (open dumping),

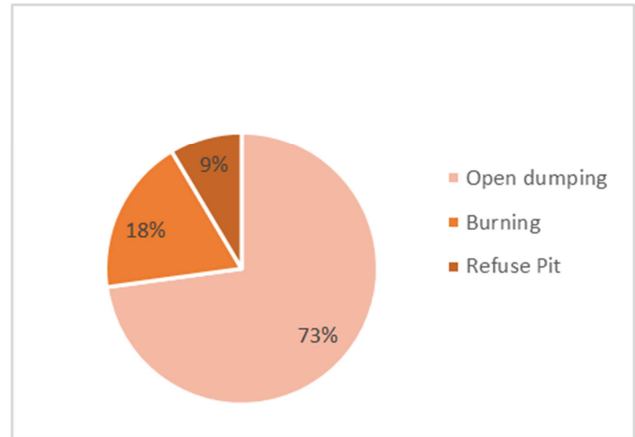


Figure 7. Methods of Domestic Solid Waste Disposal.

4. Discussion

Referring to Figure 1, 236 respondents (64%) have latrines within their households, while 136 respondents (36%) do not have any latrines within their households. This implies that 36% of households engage in open defecation. It follows therefore that Kofai community is exposed to all the risks associated with open defecation such as diarrheal morbidity and mortality, especially of the under-five. The average of diarrheal incidence for North East Nigeria is 5.5% as at 2007 (6). Other ugly health outcomes include stunting, wasting and under-weight in children; while worm infestation and associated iron deficiency anaemia (IDA) occur among adolescent girls and young mothers, which, in turn, predispose to low-birth-weight as well as to heightened vulnerability to maternal and infant mortalities.

Of course, the social and economic impacts of such open defecation on Kofai cannot be overlooked. Many still feel stigmatized by open defecation. For girls and young women, open defecation is a cause of great apprehension not only for privacy but for safety also. A study conducted in Lagos [14] found that a quarter (25%) of women experienced harassment, threat of violence or actual assault in a 12 month period as a result of exposure to open defecation. In terms of economic cost, the World Bank [10] reports that Nigeria loses N455 billion annually due to poor sanitation, of which open defecation constitute a part. This, according to the report, translates to a loss of US \$20 per capita/year or a decline of 1.3% in Nigeria's GDP [10].

But then, there is a somewhat positive side to the situation in Kofai. Kofai's household open defecation rate of 36% is 16.5% better than the Taraba State average household open defecation rate of 52.5%. It is also 1% better better than the national household open defecation rate of 37%. Conversely, access to latrines in Kofai (64%) is slightly higher than the average rate in Nigeria (63%), and far higher than the Taraba State average access of 47.5%. This must be for a reason. A number of neighbouring institutions and projects have exerted many years of positive impact upon them and uplifted the socio-economic demographics of Kofai including

the Advanced Teachers College (ATC) established in 1977; the College of Agriculture, Jalingo, established in 1979; the strategic Jalingo-Garba-Chede Road that traversed Kofai territory; and the Taraba State University, Jalingo established in 2007.

In figure 2, of the 238 households with latrines, 42.4% were pit latrines with slab/platforms; 39.0% were pour flush latrines; while 18.6% were cistern-flush septic tank system. This implies that all the latrines (100%) met the requirements for classification as “improved sanitation facilities”. Accordingly, in the 4-rung “Sanitation Ladder” [6], kofai community, speaking figuratively, has one leg on the 1st bottom-rung of “open defecation”, while the other leg is on the topmost 4th rung of “improved sanitation facilities” in the “Sanitation Ladder”. This scenario of Kofai having her two legs simultaneously on the 1st and 4th rungs of the “Sanitation Ladder” has a practical prospect. By focusing attack on open defecation through the deployment of sustained community led total sanitation (CLTS) strategy, it is feasible to trigger accelerated access to improved sanitation in kofai and move the community upwards to open defecation free (ODF) status within the next five years.

From Figure 2 also, we can deduce another challenge. Since 137 households, altogether, use the septic tank and pour-flush latrines, the availability and affordability of water to flush the latrines becomes a serious issue for consideration. Water availability and affordability will influence the hygienic conditions of the latrines, as well as the provision and use of hand washing facilities. From Table 1, showing the socio-demographic characteristics of respondents, we can estimate the average number of persons in each household as 5. If we consider the recommendation by FMWR that one bucket of water should be used to flush the latrine after each use, then about 75 litres of water shall be needed daily to flush and maintain the latrines. For other domestic needs, another 175 litres of water may be required daily.

Figure 5 gives us all the sources of water availability to community members in Kofai, the most popular sources being water vendors (35%); boreholes (25%) and wells (19%). But then, water vendors in Kofai sell a 25-litre jerry can of water for twenty naira (N20). This means that the 35% of households that depend on water vendors will spend N60/day for water to flush and maintain their latrines, and another N140/day for water to service other domestic needs. In a month, this will amount to N1, 800 and N4, 200 respectively. Such cost outlay for water needs is clearly cumbersome for rural community dwellers in a country still struggling to meet a national minimum wage of N18, 000/month. Little wonder, then, that most latrines in kofai, were in poor hygienic conditions, and hand washing facilities were lacking as shown in Figures 3 and 4, respectively. This situation is obtainable in many other developing countries [1, 15].

The combined effect of Figures 5 and 6 will give a rough picture of the safety of drinking water in Kofai, but with slight uncertainties remaining unresolved. We can reasonably say, with a degree of certainty, that the 3% of

households with pipeline water supply in Figure 5 and the 18.6% that boil their water before use in Figure 6 have access to safe drinking water. But mindful that we are dealing with a rural community in a resource-constrained setting, ‘partial safety’ consideration can be accorded to the borehole source and to rain water collected with clean receptacles in open spaces.

Water vendors remain the most popular source of drinking water in Kofai. Principally, such water vendors operate with plastic cans conveyed in pushcarts that carry 10-12 cans. Many authorities [16-18] have highlighted the utility value and advantages of retail water vending including penetration, reach, acceptability, flexibility and promptness. However, Ahmad [19] documents the many unhealthy practices of retail water vendors including using their mouth to drink directly from the cans; using sand to wash the cans; puncturing the cans to ease off pressure; and sometimes leaving the cover of the cans unfastened. Inadvertently, the same can that is used to draw water from a well or stream to supply to a launderer or block molder is still used to supply to other householders for domestic use including drinking and preparation of food.

It does appear that the use of chlorine tablet for water treatment has gained some ground in Kofai. The use of chlorine tablet is effective per se, however, proper dosing and appropriate retention period still remain a challenge to the ordinary user. It does not appear to us that the method of filtering with cloth which 16.1% of the households embark on can be relied upon as an effective water treatment option. Nevertheless, it would be of interest for further research to understand why such practice had gained ground in the community.

Taking a more curious look at Figure 6 would inevitably prompt a relevant question. Why would a whopping 222 households, approximately 60% of the community, not treat their drinking water at all? Even if one discounts those that rely on pipe borne water (3%), boreholes (25%) and rain water (10%) as safe sources - all amounting to 38% of households, it may not provide sufficient explanation for the remaining gap. Neither can the gap be explained away as attributable to ignorance considering the educational and occupational background of the respondents. It is possible that an underlying cultural belief may have reinforced the attitude of many that their water is safe without further treatment.

In any rural community where household refuse is not separated (garbage and rubbish) at source, open dumping is inevitable, for obvious reasons. First, the quantity of mixed refuse generated will be overwhelmingly large. Second, the capacity (institutional, technological, financial, etc) to treat and dispose such refuse by conventional methods will be over-stretched. Third, where large expanses of land (farms, bushes, forests) are readily available, they are used as sites for open dumping, apparently, without any further financial cost to the rural dwellers. This must be the case with Kofai, and explains why 72.9% households embark on open dumping of

refuse. It does appear, however, that households that generate mostly combustible wastes resort to burning, whereas non-combustible wastes as cans are buried in pits in order not to affect cultivation activities in farmlands.

5. Conclusion

Kofai is a rural agricultural community in Ardo-Kola Local Government Area of Taraba State, North-East, Nigeria. She is however undergoing rapid transformation owing to the impact of modern socio-economic development within and proximal to her vast territory. Water, sanitation and hygiene (WASH) practices and infrastructure in Kofai are in a phase of transition. Though open defecation is still practiced, improved latrines are predominant. By deploying appropriate triggering intervention through a sustained community led total sanitation (CLTS), Kofai has potentials to attain open defecation free (ODF) status in 5 years in line with Nigeria's Road Map/Policy of making Nigeria Open Defecation Free by 2025.

6. Recommendations

1. Immediate enrolment of kofai in the CLTS program of Taraba State should be facilitated.
2. The CLTS program in Kofai should focus, among others, on the provision of cheap sanitary pit latrines in the first phase, and pour flush latrines, in the second phase of its intervention to eliminate open defecation as soon as practicable.
3. The water table in Kofai is favourable to wells. Accordingly, provision of affordable wells should be encouraged to expand water supply.
4. To safeguard their drinking water, all householders should be sensitized and mobilized to, at least, boil their drinking water before use.
5. Plastic and polythene waste is a current challenge in all parts of Nigeria, both for urban and rural communities. To forestall or minimize the adverse effects of plastic and polythene wastes on farming, it is advisable for Kofai to designate a common location for collection of such plastic and polythene wastes for eventual evacuation to approved dump-site.

7. Suggestions for Further Research

To contribute further in building up the knowledge base on Kofai, the following researches are suggested:

1. Evaluation of the health awareness level (knowledge, attitude, and practice) of members of Kofai community, focusing on contemporary health issues.
2. Assessment of the incidence, prevalence and impact of common endemic diseases on Kofai.
3. Assessment of the chemical and biological qualities of various sources of water in Kofai with special focus on boreholes and wells.

Conflict of Interest

All the authors do not have any possible conflicts of interest.

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References

- [1] Orimoloye, E. O., Amadi, C. O. A., Amadi, A. N., Azuamah, Y. C., Nwoke, E. A., Zacchaeus, U., Dozie, I. N. S. (2015). Assessment of water sanitation and hygiene practices in Ibadan, Nigeria. *International Journal of Research*, 2 (2), 94-100.
- [2] WHO & UNICEF. (2015). Progress on sanitation and drinking water: 2015 update and MDG assessment. World Health Organization.
- [3] Prüss-Üstün, A., Bos, R., Gore, F., Bartram, J. (2008). Safer water, better health: Costs, benefits and sustainability of interventions to protect and promote health. World Health Organization, Geneva.
- [4] Roche, R., Bain, R. and Cumming, O. (2017). Correction: A long way to go - Estimates of combined water, sanitation and hygiene coverage for 25 sub-Saharan African countries. *PLoS One*, 12 (3): e0173702. <https://doi.org/10.1371/journal.pone.0173702>.
- [5] World Health Organization. (2014). UN-water global analysis and assessment of sanitation and drinking-water (GLAAS) 2014 report. Investing in water and sanitation: Increasing access, reducing inequalities. Assessed from https://www.who.int/water_sanitation_health/publications/glaas_report_2014/en/.
- [6] Federal Ministry of Water Resources. (2016). Making Nigeria Open Defecation Free by 2025: A National Roadmap. Assessed from <https://www.unicef.org/nigeria/media/1491/file/Nigeria-making-Nigeria-open-defecation-free-by-2025.pdf.pdf>.
- [7] Liu, L., Johnson, H. L., Cousens, S., Perin, J., Scott, S., Lawn, J. E.,... & Mathers, C. (2012). Global, regional, and national causes of child mortality: an updated systematic analysis for 2010 with time trends since 2000. *The Lancet*, 379 (9832), 2151-2161.
- [8] Walker, C. L. F., Walker, N. (2014). The Lives Saved Tool (LiST) as a model for diarrhea mortality reduction. *BMC Medicine*, 12 (1), 70. <https://doi.org/10.1186/1741-7015-12-70>.
- [9] Walker, C. L. F., Rudan, I., Liu, L., Nair, H., Theodoratou, E., Bhutta, Z. A.,...& Black, R. E. (2013). Global burden of childhood pneumonia and diarrhoea. *The Lancet*, 381 (9875), 1405-1416.

- [10] Maina, S. W., Sittoni, T. (2012). Nigeria loses NGN455 billion annually due to poor sanitation (English). Economic impacts of poor sanitation in Africa; Water and sanitation program. Washington, DC: World Bank. Available from <http://documents.worldbank.org/curated/en/855961468297356898/Nigeria-loses-NGN455-billion-annually-due-to-poor-sanitation>.
- [11] WHO & UNICEF. (2020). Water, sanitation, hygiene, and waste management for the COVID-19 virus: interim guidance, 19 March 2020. World Health Organization. <https://apps.who.int/iris/handle/10665/331499>.
- [12] District Health Information Management System. (2017). Primary Health Centre, Ador Kola LGA, Taraba State.
- [13] Ellen, S. (2020). Slovin's Formula Sampling Techniques. [sciencing.com](https://sciencing.com/slovin-formula-sampling-techniques-5475547.html). Retrieved from <https://sciencing.com/slovin-formula-sampling-techniques-5475547.html>.
- [14] Water-Aid. (2013). We Can't Wait: A Report on Sanitation and Hygiene for Women and Girls. Assessed from <https://washmatters.wateraid.org/publications/we-cant-wait-a-report-on-sanitation-and-hygiene-for-women-and-girls>.
- [15] Amadi, A. N. (2011): ABC of Environmental Health. Owerri: Readon Publishers Limited.
- [16] Onyenechere, E. C., Eleazu, E. I., Azuwiki, O. D., Osuji, S., Igwe, C. F. (2012). The dynamics of domestic water vending in Enugu North LGA of Enugu State, Nigeria. *Journal of Water Resource and Protection*, 4 (4), 224-230. doi: 10.4236/jwarp.2012.44025.
- [17] Wutich, A., Beresford, M., Carvajal, C. (2016). Can informal water vendors deliver on the promise of a human right to water? Results from Cochabamba, Bolivia. *World Development*, 79; 14-24. doi: 10.1016/j.worlddev.2015.10.043.
- [18] Nnaji, C. C., Eluwa, C., Nwoji, C. (2013). Dynamics of domestic water supply and consumption in a semi-urban Nigerian city. *Habitat International*, 40, 127-135.
- [19] Ahmad, M. T. (2017). The role of water vendors in water service delivery in developing countries: a case of Dala local government, Kano, Nigeria. *Applied Water Science*, 7 (3), 1191-1201. <https://doi.org/10.1007/s13201-016-0507-z>.