

Quality Assessment Of Public Pipe Borne Water Supply And It's Implications For Public Safety In Abuja Metropolis, Nigeria

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Abstract

Public pipe borne water quality assessment of Abuja Metropolis was investigated for two years with the aim to assess its public health safety. Representative water samples were collected from each of the five major districts both in rainy and dry seasons according to standard methods and procedures and screened for colour, Turbidity, PH, residual chlorine, total coli forms and Escherichia Coli within the period of study. The results indicated as follows: colour (8.10 ± 0.55 - 10.01 ± 0.97 Pt.Co), turbidity(1.42 ± 0.43 - 2.69 ± 0.41 NUT), pH (6.5 ± 0.22 - 7.23 ± 0.87), residual chlorine (0.09 ± 0.03 - 0.12 ± 0.03 mg/l-1), total coli forms(0 ± 0 - 10.30 ± 1.78 cfu/100ml) and E.Coli (0 ± 0 - 0 ± 0 cfu/100ml). The study found that parameters were within the respective guideline values recommended by the WHO against each parameter for safe drinking water quality accept for residual chlorine and particularly during the raining season. The study also observed that the so also the PH of the water supply was in the majority cases across the districts were below 7.0 The study therefore concluded that the public water supply in Abuja Metropolis may not constitute any significant health risk upon consumption based on the established empirical scientific evidence and recommended improvement in the chlorine dosing threshold particularly during rainy seasons as well as prompt maintenance of leakages and faults along water distribution system.

(I) Introduction:

Water is essential to life; however, more than one million people worldwide do not have access to safe drinking water [1]. Waterborne diseases have been estimated to cause more than two million deaths and four billion cases of diarrhoea annually [1]. Lack of adequate supply of potable water is a critical challenge in developing countries such as Nigeria. Potable water, also called drinking water in reference to its intended use, is defined as water which is fit for consumption by humans and other animals [2]. One of the targets of the Millennium Development Goals (MGDs) in terms of healthy living for the masses can be achieved through the supply of safe and convenient water, [3]. The quality of water influences the health status of any populace, hence analysis of water for physical, biological and chemical properties including trace element contents are very important health studies [4]. Water is a vital source of human existence since the body of man is made up of 70% water and gets thirsty when 1% loss of fluid even risks death when up to 10% loss of the

fluid [5]. The basic physiological requirement for drinking water has been estimated at about 2 litres per person per day. Also 140-160 litres per capita per day are considered to meet most of the domestic needs [6]. [7] in an assessment of water quality and domestic uses in medium-sized towns of Niger State, Nigeria observed that since independence of Nigeria in 1960, many water supply schemes have been and are still being commissioned to satisfy political promises and aspirations without resources maintenance consideration. People in many parts of the world today are faced with the problem of water paucity and insecurity [8]. The most obvious concern about an unsafe water supply is the health risk to family or guests. Although Nigeria is known to be faced with abundant water resources, the availability of potable water is a problem in many parts of the country [9].

[10] in an assessment study of portable water supply and demand in Jema; a Local Government Area of Kaduna State, Nigeria found that among others that the rapid population growth, increase standard of living and purchasing power,

changes in social taste and policy decisions are all important controls on water demands in the study area and the study also revealed that an individual needs an average quantity of 37.45 litres of water per day. The low service level of water accounts for prevalence of water borne diseases which could get to epidemic if not attended to promptly

[11].in the study of quality status of sources of drinking water supply in Gombe metropolis, Nigeria found that the quality has generally improved significantly within the last decade as a result of intervention of the State, Federal Government and international agencies such as the UNICEF/DFID Many households, often the poorest, end up purchasing water from private vendors much more expensive than from the public supply. Water supply services, where they exist, are unreliable and of low quality and are not sustainable because of difficulties in management, operation and pricing and failure to recover costs.

In a study a studied of the environmental impact on the bacteriological quality of domestic water supplies in Lagos State, Nigeria by [12] with the objective to assess the impact of town planning,

infrastructure, sanitation and rain fall on the bacteriological quality of domestic water supplies. It was found that contamination of treated and pipe distributed water was related with distance of the collection point from a utility station, faults in pipelines increases the rate of contamination ($P<0.05$) and this occurred mostly in densely populated areas with dilapidated infrastructure. Waste water from drains was the main source of contamination of pipe borne water. Contamination was higher during the period of heavy rainfall ($P<0.05$). E-conforms were isolated from the water supplies.

In a study of impact of introduction of treated water on community health in South Africa concluded that there was no correlation between water quality and diarrhoea per se. However, there was a marked decrease in diarrhoea with the introduction of the new water supply. There was definite correlation between hygiene behaviors and diarrhoea. According to the author, in South Africa, 7million people do not have access to adequate supply of portable water, and one half of the population (21million) lacks basic sanitation. It was estimated that there are approximately 24 million incidences of diarrhoea per year in South

Africa, of which 2.8million require treatment at health care facilities and 43,000 people die annually, [13].

Infectious diseases caused by pathogenic viruses are the most common and widespread health risk associated with drinking water. The pathogens that may be transmitted through contaminated drinking water are diverse. While many of the pathogens are known, it is unlikely that all water-borne pathogens have yet been recognized. For pathogens transmitted by the faecal-oral route, drinking water is only one vehicle of transmission. Contamination of food, hands, utensils and clothing can also play a role, particularly when domestic sanitation and hygiene is poor. Due to this multiplicity of transmission routes, improvements in the quality and availability of water, in excreta disposal and in general hygiene education are all important factors in achieving reductions in morbidity and mortality rates of faecal origin , [14]

Rapid assessment of drinking water Quality in the Federal Republic of Nigeria Country Report indicated that water sources in many parts of the country had a low pH, and only 56% of the samples tested nationally were in compliance

with the WHO suggested range (6.5–8.5). . The quality of the water supplied by the public water agencies is of serious concern. For turbidity, the national compliance level for water samples taken from utility pipes was only 55%, and those for coli forms and faecal streptococci were 77% and 75%, respectively. Moreover, in the majority of the samples, no free chlorine was detected – only 4% of the 71 samples tested had enough free chlorine to mitigate bacteriological risk. It therefore recommended that a national regulatory agency with an effective enforcement mechanism be put in place to ensure the sanitary integrity of the water supply schemes, [15].

The Nigerian Government has long considered the provision of water supply services to be the domain of the Federal, State and Local Governments. However, the public sector has not been successful in meeting more than a small portion of the demand for water of residential and commercial users. Services are in critical short supply, [16].

In Nigeria, contaminations of drinking water with pathogens have also been reported in several other metropolis /cities [17,18,19]. Waterborne outbreaks of enteric disease have occurred either

when public drinking water supplies were not adequately treated after contamination with surface water or when surface waters contaminated with enteric pathogens have been used for recreational purpose [20]. The public water supply in the Abuja metropolis commenced in 1987 and since then, water supply has been fairly regular in the metropolis but in a study of socio –Environmental consideration at the Usuma reservoir about 26 kilometer from the Abuja metropolis by [21] reported high incidence of water borne diseases suffered among the communities and this underscores the relevant of the study.

(III) MATERIALS AND METHODS:

The Study Area:

The Abuja Metropolis (Figure 1) is located between latitude 9° 2' 7" and 9° 7' 7" N and longitude 19° 27' 14" and 19° 32' 14" E., see table 1 .The Metropolis is bounded in the East by Karu and Nyanya satellite towns. In the North by Katampe, Mabushi and Mpape districts which could be described as urban slumps. In the west by Utako and Wuye districts and in the south by Durumi, Gudu districts. The study area has witnessed a tremendous population growth of in

the past two decades following the movement of the Federal Capital of Nigeria from Lagos to Abuja in 1991. The metropolis grew from a population of 226,949(1991), 403,000(1999) to 778,567 in 2006, [22].2, 514,413 in 2012.According to official estimates, Abuja has been growing at 9.3% per year [23].

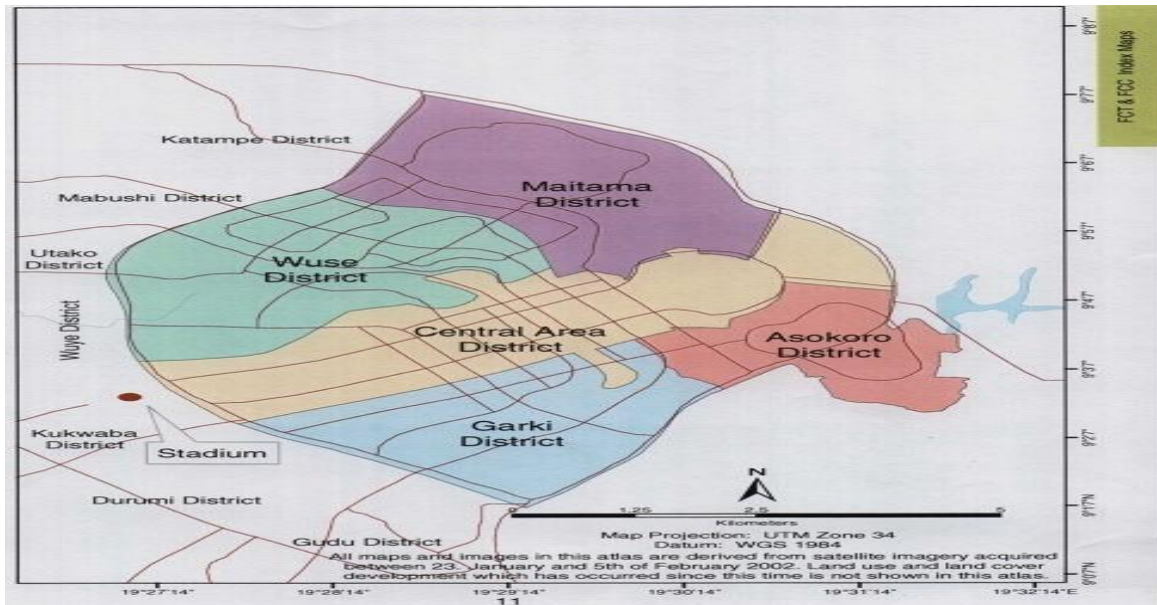
Weather and Seasons : The rainy season begins from April and ends in October, when daytime temperatures reach 28 °C (82.4 °F) to 30 °C (86.0 °F) and night-time lows hover around 22 °C (71.6 °F) to 23 °C (73.4 °F). In the dry season, daytime temperatures can soar as high as 40 °C (104.0 °F) and night-time temperatures can dip to 12 °C (53.6 °F). The high altitudes and undulating terrain of the metropolis act as a moderating influence on the weather of the territory. Rainfall in the FCT reflects the territory's location on the windward side of the Jos Plateau and the zone of rising air masses with the city receiving frequent rainfall during the rainy season from March to November every year, The metropolis falls within the Guinean forest-savannah mosaic zone of the West African sub-region. The geographical locations of the districts are: Asokoro (7°33'00"E & 9°3' 05"N),

Central Area District(7° 30′ 01″E & 9° 2′ 05″N),
Garki District(7° 32′ 50″E & 9° 01′ 30″N),

Maitama District(7° 30′ 20″E & 9° 6′ 00″N) and
Wuse District (7° 29′ 50″ E & 9° 5′ 35″N).

A Map of Abuja showing the

www.wikipedia.com



five major Districts. Source:

(i) Stations and Sampling Method:

Five sub-stations were established within the main stations of Asokoro, Central Area, Garki, Maitama and Wuse to provide a representation sample from each district for analysis. The sampling stations are shown in table 1 above. Water samplings were carried out in 2009 and 2010 during the months January, March, May, July, September, and November in each year covering dry and wet seasons in a year . Three replica samples were taken each month from each station to obtain the monthly mean value. A

sample representative of each district was obtained from the sub-sample stations designated in each of the districts. Water samples were taken before 12 noon each day , transported to the laboratory in a cooler maintained at the ambient temperature and subsequently analyzed within two hours of collection according to Standard Methods and Procedures stipulated in [24].

(ii) Water Quality Analysis:

Colour in drinking water may be due to the presence of coloured organic matter eg humic

substances, metals such as iron or manganese or highly coloured industrial wastes. Changes in drinking water colour may be attributed to degradation of the source water, corrosion problems in the distribution systems or other factors such as changes in the quality of activated carbon in the filtration process. It was measured by DR-5000 HACH Meter in platinum Cobalt unit (Pt.Co). The WHO recommended maximum permissible colour of drinking water is 15 Pt.Co. P^H is the hydrogen ion concentration in a given water sample and it affects treatment process, especially coagulation and disinfection with chlorine-based chemicals. Changes in PH of source water should be investigated as it is a relatively stable parameter over a short term and any unusual change may reflect a major event. PH is commonly adjusted as part of the treatment process and is continuously monitored because it determines the concentration of other parameters, [30]. It is a critical parameter in drinking water quality control and surveillance[25]. The PH was determined with PH-Meter (EoTerr) and the results are shown in table 3.

Turbidity is a measure of suspended solids. It has been singled out here because it is the probably the most generally applicable and widely used non—microbial parameter that can provide the most significant data throughout the water abstraction and treatment process. It is not associated specifically with facial materials, but increase in turbidity are often accompanied with increase in pathogens numbers., including cysts or oocysts, [25]. Turbidity was often determined with a Turbidity Meter (HANNA-LP 2000-11). It works on the principle of measuring the amount of light scattered by the particulate matter in the water using a nephelometer. Instrument for measuring turbidity are calibrated using commercially available certified standardized suspensions of formazin defined in Nephelometric. The WHO recommended turbidity level in drinking water is 5NTU. Residual chlorine from the layman point of view is “ the available chlorine in the drinking water that protects/kills or inactivate any pathogenic agent found in the water stream” Therefore, disinfection of drinking-water supplies constitutes an important process against drinking water contamination and therefore minimize waterborne

diseases. The absence of a chlorine residual in the distribution system may, in certain circumstances, indicate the possibility of post-treatment contamination, [26]. In this study residual chlorine was determined with Chlorine Colorimeter (HACH –Test Kit, Cat No 58700-00 using appropriate reagents .

The total coli forms bacteria and Escherichia coli forms (*E.Coli*) were determined with the Membrane-Filtration (MF) method, according to the standard methods and procedures – The WHO recommended guideline value for both bacteriological parameters in drinking water is 10 cfu/10ml and 0 cfu/100ml for total coliform and *E. Coli* respectively. The results of the bacteriological analysis of public pipe boren water supply in Abuja Metropolis within the period of this study are presented in table 1 and 2 respectively.

Statistical Analysis:

An Excel –Analyze-it 2006 version was used to compare the groups and obtained the sample mean, standard deviation and percentage compliance with the WHO recommended values. As well as significant deference ($P < 0.05$) between parameters in districts and seasons within 95% confidence limit.

(IV) RESULTS AND DISCUSSIONS

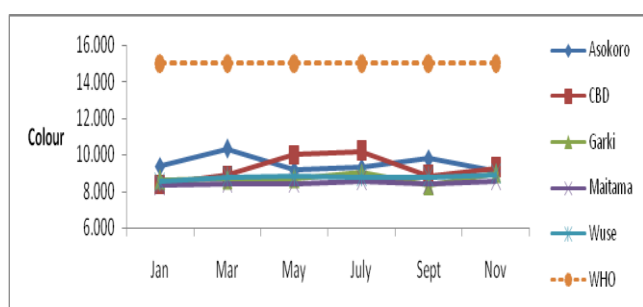
Colour of the public water in the five major districts (Asokoro, Central Area, Garki, Maitama & Wuse) that make up the Abuja Metropolis was determined within the two year study period (2009 & 2010) .It ranged from 8.39 ± 0.22 in Maitama to 9.47 ± 0.86 in Asokoro in 2009 dry season. In 2010 the dry season (from 9.75 ± 1.18 in Asokoro to 9.13 ± 0.45 in the Central Area District. In rainy season of the same year, it ranged from 8.10 ± 0.55 in Maitama to 9.32 ± 1.20 in Central District. Generally, there is no significant ($p < 0.01$) difference between the colour in dry and rainy seasons within the two year study period. However, the slight colour quality depreciation was observed during the rainy season .This could be as a result of organic matter content in the source water which was not be properly removed during the treatment or secondary contamination from a highly coloured industrial waste. Generally the colour value were within permissible limits recommended by WHO , see table 1 while a time-series analysis of the mean colour conformity with WHO standard is shown in graph 1.

Table 1: Mean Colour (Pt.Co) Variations of Public Water Supply Across five Major Districts in Abuja Metropolis,

Sample Sites	2009		2010	
	Dry Season	Rainy Season	Dry Season	Rainy Season
Asokoro District	9.47±0.8 6	8.83±0.5 9	9.75±1.18	10.01±0.9 7
Central District	8.56±0.6 9	9.32±1.2 0	9.13±0.4 5	10.01±0.3 9

Garki District	8.60±0.2 0	8.25±0.5 7	8.89±0.2 9	9.12±0.49
Maitama District	8.39±0.2 2	8.10±0.5 5	8.47±0.11	8.82±0.39
Wuse District	8.77±0.2 3	8.47±0.5 7	8.72±0.3 9	9.08±0.54
NSDQW/WHO	15	15	15	15

Graph 1: Mean Colour Values of Public water supply in the selected District in Abuja Metropolis and its compliance with WHO Guideline limit .



Colour in water result from the presence of natural metallic ions (iron, manganese), humus, peat materials, plankton, weeds and industrial wastes. Colour is removed to make water suitable for general and industrial applications. Generally, Changes in colour from that normally seen can be can provide warning of possible quality changes or maintenance issues and should be investigated. It could be a reflection of the source water, corrosion problems in distribution systems, and changes in the performance of adsorptive treatment processes [26] .It was also observed that the use of colour as water quality

parameters by contemporary scholars is limited in contemporary studies. This could be due to its non-human health implications except just for aesthetics.

Turbidity results indicated that in 2009 dry season, it ranged from 1.50 ± 0.67 in the central district to 2.35 ± 0.59 in Maitama district. In the same year of rainy season , it ranged from 1.38 ± 0.44 in Wuse District to 2.19 ± 0.49 in Maitama District .In 2010 dry season 1.80 ± 0.44 in Wuse District to 2.33 ± 0.55 in Maitama District.. In the same year of its rainy season, it ranged from 1.65 ± 0.43 in Wuse District to 2.69 ± 0.41 in Maitama District, see table 3 and graph 2 below on compliance with WHO recommended limit.

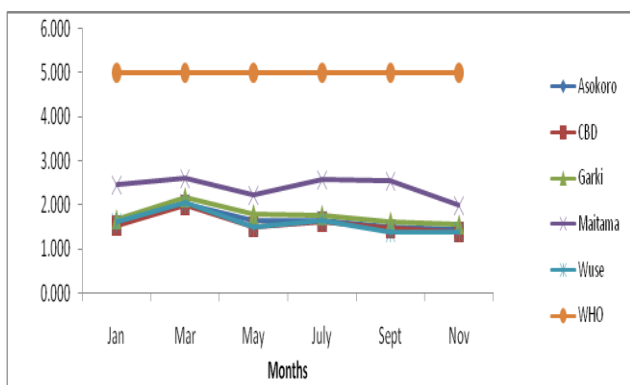
There was no significance ($P<0.05$) between the turbidity vales across the seasons except between Maitama ($P>0.05$) with other Districts during the study period Generally, the turbidity results

were within the accepted limits of 5NTU by the WHO and therefore may not constitute any danger in the drinking water supply, see table 2 and graph 2

Table 2: Mean Turbidity (NUT) variations of Public Water Supply Across five (5) Major Districts in Abuja Metropolis (2009-2010)

Sample Sites	2009		2010	
	Dry Season	Rainy Season	Dry Season	Rainy Season
Asokoro District	1.57±0.72	1.42±0.4 5	1.79±0.81	1.75±0.3 3
Central District	1.50±0.67	1.42±0.4 3	1.78±0.81	1.62±0.3 9
Garki District	1.69±0.72	1.68±0.4 2	1.92±0.83	1.78±0.38 ±
Maitama District	2.35±0.5 9	2.19±0.4 9	2.33±0.5 5	2.69±0.4 1
Wuse District	1.55±0.21	1.38±0.4 4	1.80±0.87	1.65±0.4 3
NSDQW/WHO	5	5	5	5

Graph 2: Mean Turbidity Values of Public water supply in the selected District in Abuja Metropolis and its compliance with WHO Guideline limit over time(2009-2010).



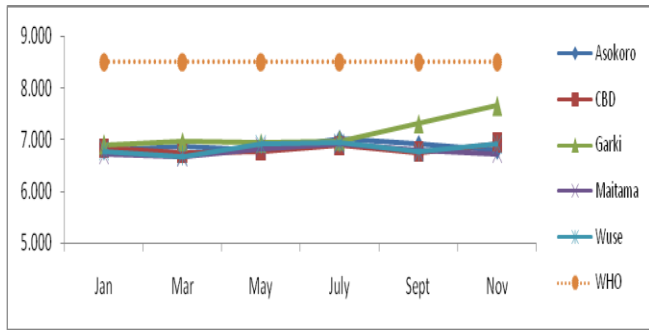
The results of the P^H assessment is shown in table 4 over the period and its seasons .It showed a stability value of range 6.65±0.22 in Maitama District to 7.12±0.60 in Garki District in 2009

dry season. In the same year of its rainy season, it varied from a mean value 6.79±0.19 to 7.03±0.23 in Garki District. In 2010 dry season, it varied from a mean of 6.74±0.16 in Maitama District to 7.03±0.87 in Garki District., whereas in the dry season, it varied from 6.68±0.15 in Asokoro District to 7.11±0.60 in Garki District, see table 3 and graph 3 on compliance with WHO limit.

Table 4: Mean P^H Variations of Public Water Supply Across five (5)Major Districts in Abuja Metropolis (2009-2010)

Sample Sites	2009		2010	
	Dry Season	Rainy Season	Dry Season	Rainy Season
Asokoro District	6.84±0.14	6.86±0.16	6.80±0.07	6.95±0.15
Central District	6.86±0.33	6.74±0.11	6.81±0.09	6.86±0.17
Garki District	7.12±0.60	7.03±0.23	7.23±0.07	7.11±0.60
Maitama District	6.65±0.22	6.79±0.19	6.74±0.16	6.89±0.15
Wuse District	6.76±0.24	6.84±0.17	6.81±0.07	6.90±0.10
WHO(WHO(Mini.))	6.5	6.5	6.5	6.5
NSDQW/WHO	8.5	8.5	8.5	8.5

Graph 3: Mean pH Values of Public water supply in the selected District in Abuja Metropolis and its compliance with WHO Guideline limit (2009-2010).



It was observed that P^H was more within the acidic scale throughout the seasons and across the districts and there was no significance difference ($P < 0.05$) between the seasonal values during the period under study. The above observation could be attributed to the residual acids radicals that sustain the disinfection of the water against pathogens during the treatment process but generally, the values were within the recommended limits and therefore safe for human consumption. However, the implications for the p^H nature of the pipe borne water supply in the study area may not be investigations to assess the impacts on the durability of the water distribution pipe lines and other engineering facilities may verified for strategic maintenance planning. The critical parameters recommended for the minimum monitoring of community supplies are those that best establish the hygienic state of the water and thus the risk of waterborne infection. The critical parameters are thus: E. coli; thermo tolerant coli forms, chlorine residual

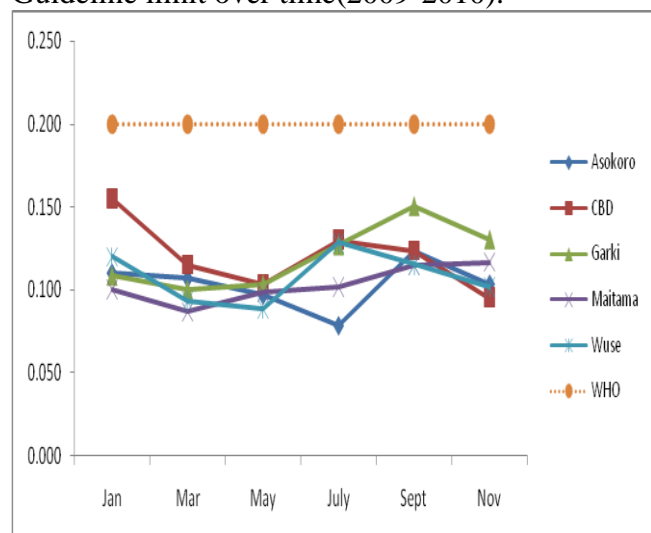
.These should be supplemented, where appropriate, by p^H and turbidity [25]. P^H of water is very important in determination of water quality since it affects other chemical reactions such as metal toxicity [26]. The use of p^H as a water quality assessment is common in the literature but the very few include, [4, 15, 27, 28]. The chlorine residual ranged from 0.06 ± 0.0 mg/l⁻¹ in Garki District to 0.12 ± 0.04 in Central Area District during the dry season of 2009. In the same year's rainy season, it ranged from 0.09 ± 0.03 mg/l⁻¹ in Wuse District to 0.12 ± 0.04 in the Central Area District. In 2010 dry season, it ranged from 0.08 ± 0.04 mg/l⁻¹ in Maitama District to 0.12 ± 0.04 mg/l⁻¹ in Central Area District and during its rainy season it varied from 0.04 ± 0.06 mg/l⁻¹ in Garki District to 0.12 ± 0.03 mg/l⁻¹ in Central Area and Wuse Districts respectively, see table 4 and graph 4 .

Table 4: Mean Residual Chlorine Variations of Public Water Supply Across five (5) Districts in Abuja Metropolis (2009-2010)

Sample Sites	2009		2010	
	Dry Season	Rainy Season	Dry Season	Rainy Season
Asokoro District	0.10±0.04 4	0.11±0.05	0.11±0.02	0.09±0.04
Central District	0.12±0.04 4	0.12±0.03 3	0.12±0.04 4	0.12±0.03
Garki District	0.06±0.05	0.11±0.04	0.14±0.05 5	0.04±0.06
Maitama District	0.12±0.03 3	0.10±0.02 2	0.08±0.04 4	0.11±0.04 4

Wuse District	0.11±0.03	0.09±0.03	0.10±0.03	0.12±0.03
NSDQW/WHO	0.20-0.25	.20-0.25	.20-0.25	.20-0.25

Graph 4: Mean R.Chlorine Values of Public water supply in the selected District in Abuja Metropolis and its compliance with WHO Guideline limit over time(2009-2010).



. The residual chlorine across the sample sites were fairly uniform in value but were higher in rainy seasons. This could be from the dosing source bearing in mind that possibility of water contamination is always more in the rainy seasons and therefore extra attention is ensured during treatment.

It was observed that there was a significance difference ($P>0.05$) between the chlorine residuals across the districts and in between the seasons. Generally, it was slightly off the specification of the WHO and NSDQ guideline value range of $0.20-0.25\text{mg/l}^{-1}$. The implication of the finding is worrisome as it makes the public

water supply dangerously vulnerable to secondary contamination and thereby predisposes the consumer to water borne diseases such as diarrhea typhoid fever, dysentery, shistosomiasis etc. The presence of chlorine residual in drinking water indicates that a sufficient amount of chlorine was added initially to the water to inactivate the bacteria and some viruses that cause diarrheal disease; and, the water is protected from recontamination during storage. The presence of free residual chlorine in drinking water is correlated with the absence of disease-causing organisms, and thus is a measure of the portability of water. In terms of compliance with the recommended values, it could be said that the compliance of public water supply in Abuja Metropolis during the period of study was between 50-55%. The implication is that the public pipe water could easily be secondarily contaminated on slight contact due to breakages or faults along the distribution lines.

This observation was a contradiction of the some studies such as in Akwa Ibom State in Nigeria where it was observed that the chlorine residual in public water supply was in consonance with the international specification. Residual chlorine is the chlorine available to inactivate disease-

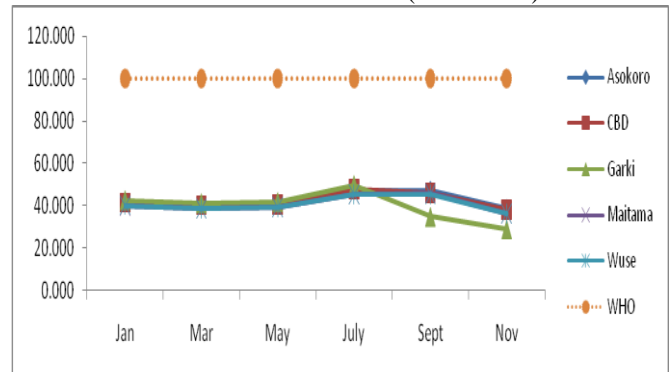
causing organisms, and thus a measure to determine the portability of water, [29].

The results of the mean total coli form bacteriological assessment in the public pipe borne water supply in Abuja Metropolis within the study period is shown in table 5. It was virtually not detected in 2009 dry season, but got detected during the rainy season in Wuse District, ranging from 3.0 ± 11 in Maitama District to 13.00 ± 0.93 cfu/100ml in Wuse District. In 2010, it was virtually not detected but also found slightly during the rainy season ranging from 4.00 ± 0.93 in Wuse District to 8.01 ± 1.78 in Asokoro District, see table 6 and time series variation analysis across districts over time in Table 5 Graph 5

Wuse District	0±0	13.00±0.93	0.00±0.70	4.00±0.93
*NSDQW/WHO	10	10	10	10

* Nigerian Standard for Drinking Water Quality (NSDQW)

Graph 5: Mean T. Coliforms of Public water supply in the selected District in Abuja Metropolis and its compliance with WHO Guideline limit over time(2009-2010).



The results on analysis indicated there was a significant ($p > 0.05$) difference between the dry season and raining season values throughout the period and the seasons but all the values were within the acceptable limit of 10 cfu/100ml of drinking water quality. The study also observed that drinking water supply is more vulnerable to bacterial contamination during the rainy seasons. The explanation for more bacterial in the water supply during the rainy season could be due to the flooding of water lines during the season and possible intrusion from minute cracks on the waterlines. These bacterium are microscopic could penetrate the least pore space. Total coli forms are a group of bacteria commonly found in the environment, for example in soil or

Table 5: Mean Total Coli form Quantity (cfu//100ml) Variations of Public Water Supply Across five (5) Districts in Abuja Metropolis (2009-2010)

Sample Sites	2009		2010	
	Dry Season	Rainy Season	Dry Season	Rainy Season
Asokoro District	0.00±	7.00±1.05	0.00±0.00	8.0.30±1.78
Central District	0±0	4.00±0.93	0.00±0.00	4.00±0.93
Garki District	0±0	4.00±93	0±0.93	7.00±1.05
Maitama District	0±0	3±1.11	.00±0.70	7.00±1.05

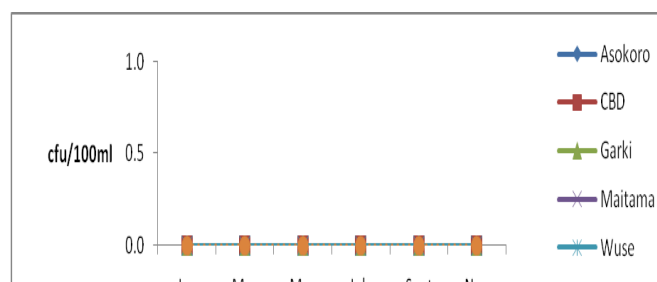
vegetation, as well as the intestines of mammals, including humans. Total coli form bacteria are not likely to cause illness, but their presence indicates that water supply may be vulnerable to contamination by more harmful microorganisms, [28]. The E .Coli was investigated in all the water samples from the districts. The result is presented in table 7 .It was not detected in the water samples from all the districts during the study period. Escherichia coli (E.coli) is the only member of the total coliform group of bacteria that is found only in the intestines of mammals, including humans, [28]. *Escherichia coli* are abundant in human and animal faeces; in fresh faeces it may attain concentrations of 10⁹ per gram. It is found in sewage, treated effluents, and all natural waters and soils subject to recent faecal contamination, whether from humans, wild animals, or agricultural activity. Recently, it has been suggested that *E. coli* may be present or even multiply in tropical waters not subject to human faecal pollution, see table 6 and graph 6 respectively.

Table 6: Mean *E. Coli* Quantity (MPN/10mm) Variations of Public Water Supply Across five (5) Districts in Abuja Metropolis (2009-2010)

Sample Sites	2009		2010	
	Dry Season	Rainy Season	Dry Season	Rainy Season
Asokoro District	0	0.00±1.05	00.0	0.30±1.78
Central District	0.0	.00.0.	00.0	.00.0
Garki District	0.0	0.00	00.0	00.0
Maitama District	0.0	0.00	00.0	00.
OWuse District	0.0	.00	00.0	00
NSDQW/WHO	0	0	0	0

Asokoro District	0	0.00±1.05	00.0	0.30±1.78
Central District	0.0	.00.0.	00.0	.00.0
Garki District	0.0	0.00	00.0	00.0
Maitama District	0.0	0.00	00.0	00.
OWuse District	0.0	.00	00.0	00
NSDQW/WHO	0	0	0	0

Graph 6: Mean E. Coliforms of Public water supply in the selected District in Abuja Metropolis and its compliance with WHO Guideline limit over time(2009-2010).



Conclusions: The quality of public pipe borne water supply in Abuja Metropolis, was found to be safe for human consumption within the period of study and measured approximately above 75 % compliance with the World Health Organization guidelines values and recommended stakeholders in the water distribution sector should re engineer the distribution water distribution network, maintain respond promptly to equipment failures, pipeline leakages as well as ensure adequate chlorine dosing particularly

during the rainy seasons to ensure water portability and public safety.

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