© 2017 IJSRST | Volume 3 | Issue 3 | Print ISSN: 2395-6011 | Online ISSN: 2395-602X
Themed Section: Science and Technology

Evaluation of Portable Water Quality in Dutsinma Town, Katsina State, Nigeria

Shamsuddeen Idris
Department of Geography, ISA Kaita College of Education, Dutsinma, Katsina State, Nigeria

ABSTRACT

The study was conducted to assess the quality of drinking water from three major sources (i.e. treated tap water, borehole water and hand pump water) in order to find out whether or not water quality parameters selected for the study are within the recommended FME (1997) water quality standard. The selected parameters were temperature, PH, taste, colour, odour, turbidity, total suspended solids, hardness, COD, BOD, colony count, coliforms and E-coli. Six sampling points were purposively selected, two points for the treated tap water, two points for boreholes and two points for hand pump. Samples were collected and analyzed for the selected parameters during rainy season. The results obtained from field and laboratory analysis were presented and discussed and comparisons were made between the results and water quality standard set by FME (1997).The data obtained at the time of the study and its comparison with water quality standard revealed that, most of the water sources in the town are safe for human consumption. However, there were slight exhibits of turbidity in samples 1 (water treatment plant), 2 (Injin kuka), 4 (Unguwar kudu hand pump) and 6(Sokoto Rima) suspended solids in tap water and BOD and colony count in all the samples. Coliform was only detected in sample 3 (Low cost hand pump).It was concluded that, occurrences of water related diseases in the town were not totally connected to poor water quality but also to poor sanitation and poor method of collection and preservation of water. One of the recommendations offered is the need for public health education/awareness through which people get acquainted with water related diseases, their health implications and how to overcome them.

Keywords : Evaluation, water, Water Quality, Dutsinma

I. INTRODUCTION

Water is one of the most vital natural resources for all lives and living creatures on earth. The main availability and quality of water always plays an important part in determining not only where people can live but also their quality of life. Even though, there has always been plenty of fresh water on Earth, water has not always been available when and where it is needed, nor it is always of suitable quality for all users, Federal Ministry of Environment (FEPA, 1996). Water is the chemical compound obtained from the fusion of two atoms of hydrogen and one atom of oxygen (H_2O). It is the only element that occurs naturally in the three states which matter can exist (solid, gas and liquid) the boiling point of water is 100^0C while the freezing point is 0^0. Water is a universal solvent dissolving a great many substances and its solubility increase with increasing temperature. Water is also a remarkable catalyst so many reactions may be slowed down or totally inhibited by lack of water. (Ayoade 1988). Water makes life possible as without it life and civilization cannot develop or survive. Water forms the largest part of most living matter. An average man is two-third water and would weigh only 13kg when completely without water (Ayoade 1988). According to Tukur and Abdulkarim (2008), water is essential for life on earth within organisms water provides the medium within which the complex metabolic process necessary for the life takes place, organism simply cannot function without water and if deprived will die quickly.

Water quality is a term used in describing the chemical, physical and biological characteristic of water, usually in respect to its suitability for an intended purpose Kiyawa (2009). These characteristics are affected by both natural processes and human activities; generally, natural water quality varies from place to place depending on climatic changes, types of soil, rocks and surfaces through which

it moves. A variety of human activities such as agriculture, mining, urban and industrial development and re-creation significantly alter the quality of natural water and change the water use potential, Federal Ministry of Environment FEPA (1996). The key to sustainable water resources is therefore, to ensure that the quality of water resources is suitable for an intended use while at the same time maintaining the quality after use. Water must be considered as a finite resource that has limits and boundaries to its availability and suitability for use (Bhatia, 2006). Toxic and hazardous substances such as heavy metals and pesticides are introduced into the aquatic environment principally from anthropogenic sources, population explosion, hap hazard rapid urbanization, industrial and technological expansion, energy utilization and waste generation from domestic and industrial sources have rendered many water resources unwholesome and hazardous to man and other living resources (FEPA, 1996). Water quality is deteriorated in less developed countries through seepage from septic tanks, discharge of untreated effluent directly into rivers, and water ways (Garret 2000). The most common form of water pollution is organic matter from domestic sewage municipal waste and agro industrial effluent. This organic matter includes fecal materials, viruses, bacteria and other biological organisms. Water borne infections include schistosomiasis, hepatitis and gastro enteritis etc. these pathogens come from the sewage discharged directly into water but can also come from storm run-off, landfills and agricultural areas (Garret, 2000).

Other causes of water quality deterioration were outline by many personalities. Maigari (2002) identified the causes as industrial activities, agricultural practices, municipal waste generation and mode of disposal, land erosion etc. According to Uchegbu (2002), various sources of water pollution are organic and inorganic waste from industrial plants, municipals waste, sediments from land erosion, oil spills and contribution from routine operations. According to Bhatia (2006), quality of drinking water has been a factor in determining human welfare, fecal pollution of drinking water has frequently caused water borne disease that have decimated the population of whole cities. Unwholesome water polluted by natural sources has cause great hardship for people forced to drink it.

II. METHODS AND MATERIAL

The field work was conducted and was divided into Pre-field work which involved reconnaissance survey of different water sources in the town for the selection of the sampling points and main field work which involved collection of water samples and laboratory analysis of the samples collected. A purposive sampling technique was adopted and samples were drawn purposefully from the three water sources (treated tap, hand pumps and boreholes). During reconnaissance survey, six sampling points were selected; two sampling points for the treated tap water, two for hands pumps and two others for boreholes. The sampling points selected were water treatment plant (production point) and Injin Kuka (consumption points) for the treated tap, Unguwar Kudu and Low coast Housing Estate for hand pumps and Sokoto Rima and Isah Kaita College of Education for Boreholes. In the case of sampling points selection, bore holes and hand pumps were purposely selected because they were the only functional ones at the time of sample collection. To the treated tap water, selection was made, because they are the busiest points where people and water vendors source their water. Six water samples were drawn from six sampling points selected, two samples from treated tap water, two samples from hand pumps and two samples from boreholes. Sampling collection was carried out thrice making a total of eighteen (18) samples for the study. Samples were collected from tap water, boreholes and hand pumps. The first samples were collected on 13th September, 2010, after one week interval, second samples were collected on 20th September, 2010, the last samples were collected on 27th September, 2010. Samples were collected during this period (rainy season) because it is one of the most important periods for ground and surface water when new impurities are washed in to the water sources through run off and percolation. Reason behind taking one week interval was to ensure the completion of laboratory analysis of the first samples before the subsequent ones. Water samples were collected using sterile 2-liter plastic containers thoroughly washed and acidified with nitric acid and clearly marked and labelled after the sampling points, time and date. The containers were further rinsed with the sample water at the sites of the sample collection before the samples were collected to avoid

contamination. This is in accordance with Balarabe,Oladimeji and Abubakar (1998). All samples were collected between 8:00am to 10:00am and kept in coolers filled with ice blocks before they were finally conveyed to the laboratory where they were analysed for all the selected parameters. The samples were anlysed using standard laboratory methods and techniques

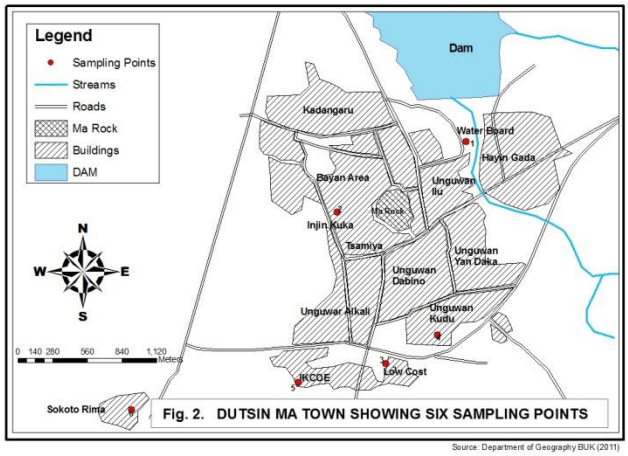


Figure 1: Map of Dutsinma town showing six sampling points

It has been stated that, samples were collected three times within three weeks (interval) and were immediately taken to the laboratory where they were analyzed for the selected water quality parameters, after the laboratory analysis of the collected water samples, three series of laboratory results were obtained. The mean or average of the three results was taken and presented on table 1 below. Thereafter the results of the parameters were interpreted accordingly and comparisons were made between the results and water quality standard of the Federal Ministry of Environment (1997).

Table 1 below shows average of the data collected from both field work and laboratory analysis

Table 1. Results of physicochemical & biological analysis of water samples in Dutsinma Town

	Samling Points					
Parameters	Water treatment plant (tap water)	Injin kuka (tap water)	Low-cost (hand pump)	Unguwar kudu (hand pump)	I.K.C.O.E D/ma (Bore hole)	Sokoto Rima (Bore hole)
Temperature	24.7^{o}c	24.3^{0}c	26.3^{o}c	28.3^{0}c	26.3^{0}c	26^{0}c
Ph	6.13	6.1	6.53	6.83	6.73	6.83
Odour	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable
Taste	Tasteless	Tasteless	Tasteless	Tasteless	Tasteless	Tasteless
Colour	5.0 HAZEN	5.0 HAZEN	<5.0 HAZEN	5.0 HAZEN	5.0 HAZEN	<5.0 HAZEN
Turbidity	4.0 N.T.U	3.66 N.T.U	1.0 N.T.U	3.0 N.T.U	1.0 N.T.U	2.7 N.T.U
Total suspended solid	12.49mg/L	12.66mg/L	3.67 mg/L	8.67mg/L	4.2mg/L	4.83mg/L
Hardness	14.49mg/l	14.71mg/l	109.53mg/l	66.51mg/l	61.80mg/l	87.41mg/l
C O D	3.20 mg/L	3.34 mg/L	8.00 mg/L	4.92 mg/L	4.00 mg/L	6.40 mg/L
B O D	1.00 mg/L	1.50 mg/L	3.00 mg/L	2.00 mg/L	1.00mg/L	2.50 mg/L
Colonies count	0	2	4	2	1	2
M.P.N of coliforms organism per 100mls of sample	NIL	NIL	NIL	NIL	NIL	NIL
M.P.N of E. coli organisms per 100mls of sample	NIL	NIL	NIL	NIL	NIL	NIL

Source: Field and Laboratory work(2010)

Table 2. FME (1997) Guidelines for Drinking Water

Parameters	Unit	Guidelines
PH		6.5-8.5
Colour	(TCU)	5-15
Odour		Odourless
Taste		Tasteless
Turbidity	NTU	1.0 NTU
Total dissolved solids	Mg/L	500
Total suspended solids	Mg/L	<10
Hardness	Mg/L	200
Dissolved oxygen	Mg/L	7.5
BOD	Mg/L	0
Chloride	Mg/L	250
Nitrate	Mg/L	10.0
Copper	Mg/L	0.1
Iron	Mg/L	1.0
Lead	Mg/L	0.05
Manganese	Mg/L	0.05
Mercury	Mg/L	0.001
Zinc	Mg/L	5.0
Chromium	Mg/L	0.05
Total bacterial count in 100ml	Number/100ml	0
Total coliforms count in 100ml	Number/100ml	0
E. coli count in 100ml	Number/100ml	0

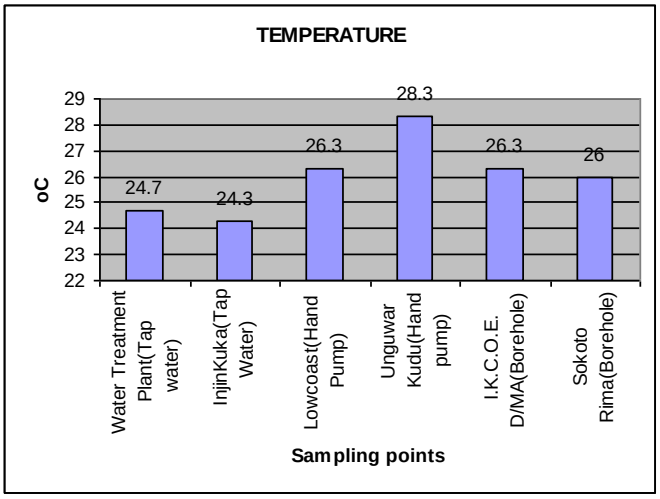
Source :- Federal Ministry of Environment (FME, 1997)

All the thirteen (13) parameters tested were detected except E. coli organism that was not detectable in all the water samples.

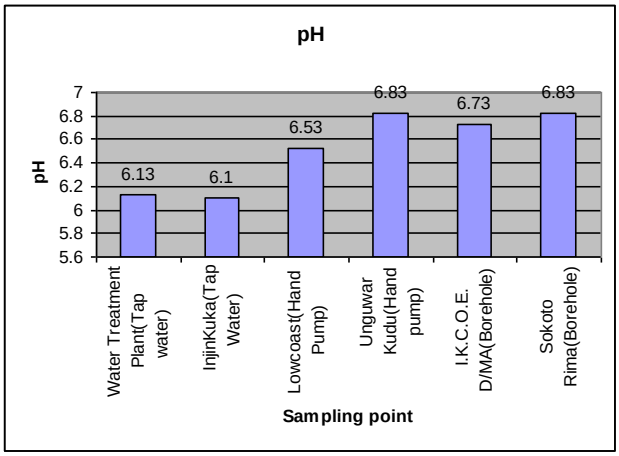
- Temperature ^{o}C and pH: Temperature and pH were observed at the time of collection of the samples. Lowest temperature of about 24.5^{o}C was recorded from sample 1(water treatment plant) and 2(injin kuka) both of which are treated tap water. Moderate temperatures around 26^{o}C were recorded from samples 3(low cost hand pump), 5(Isa Kaita College borehole) and 6(Sokoto Rima borehole). Highest temperature value (28.3^{o}C) was recorded from sample 4(Unguwar Kudu hand pump).

- pH values observed range between 6.1 to 6.8 with samples 1(Water treatment plant) and 2(Injin Kuka) having the lowest pH values. Sample 3(Low cost hand pump) recorded 6.5, sample 5 (Isa Kaita College borehole) recorded 6.7 and samples 4(Unguwar Kudu hand pump) and 6 (Sokoto Rima borehole) recorded 6.8.

Comparisons on Temperature values between the water sources



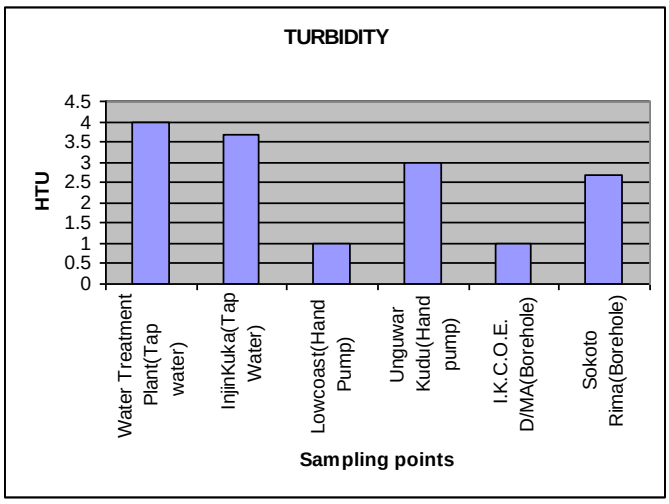
Comparisons on pH values between the water sources



- Odour, Taste and Colour: All the samples tested were odourless, tasteless and colourless respectively.

- ***Turbidity***: Higher turbidity values (3.6 – 4.0NTU) were recorded from samples 1(Water treatment plant) and 2(Injin Kuka tap water), moderate values (2.7 – 3.0 NTU) were observed from samples 4(Unguwar Kudu hand pump) and 6 (SokotoRima borehole), lowest value of 1.0 NTU was recorded from samples 3(Low cost hand pump) and 5 Isa Kaita college borehole).

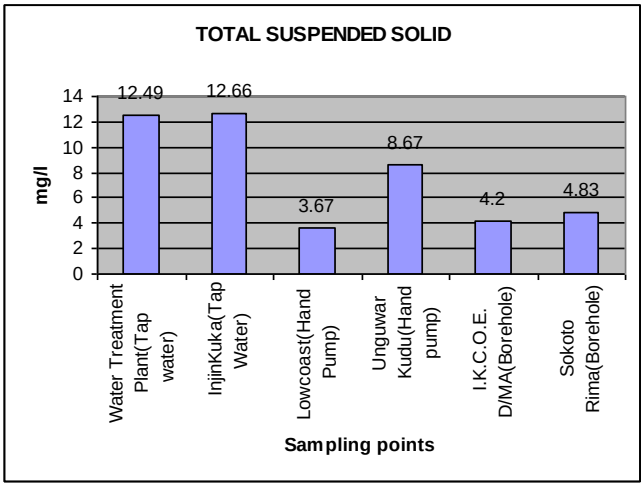
Comparisons on Turbidity values between the water sources



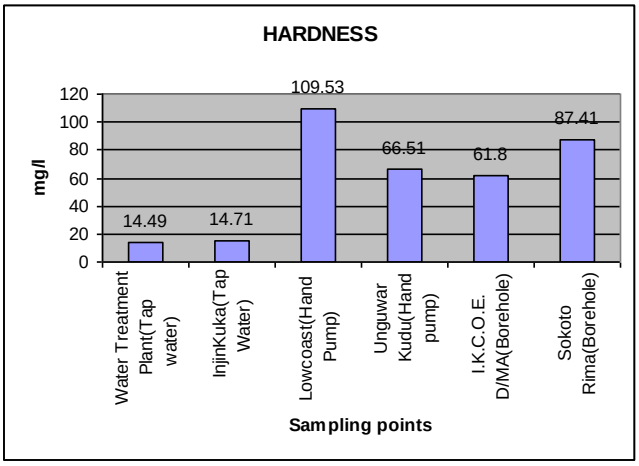
- ***Total Suspended Solids (mg/l) and Hardness (mg/l):*** Higher values of total suspended solids were observed in samples 1(Water treatment plant) and 2(Injin Kuka tap water) (12.7mg/l and 12.6mg/l), lowest values (3.67 – 4.8mg/l) were recorded in samples 3(Low cost hand pump), 5(Isa Kaita college borehole) and 6(Sokoto Rima borehole) where as moderate value (8.67mg/l) was recorded from sample 4 (Unguwar Kudu hand pump).

With regard to hardness, sample 3 (lowcost hand pump) had the highest concentration of hardness about (109.5mg/l), moderate concentration ranging between (61.8 to 87.41mg/l) were discovered in samples 4(Unguwar Kudu pump), 5(Isa Kaita college borehole) and 6(Sokoto Rima borehole) and lowest values of (14.49 and 14.47mg/l) were recorded from sample 1(Water treatment plant) and 2 (Injin Kuka treated tap water).

Comparisons on total suspended solids between the water sources

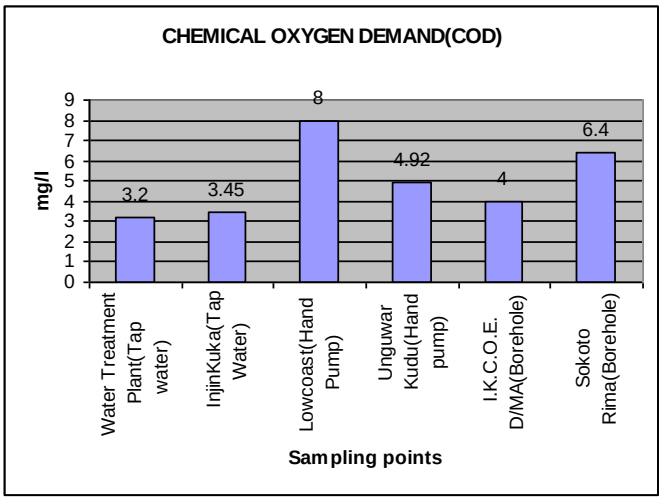


Comparisons on total hardness between the water sources

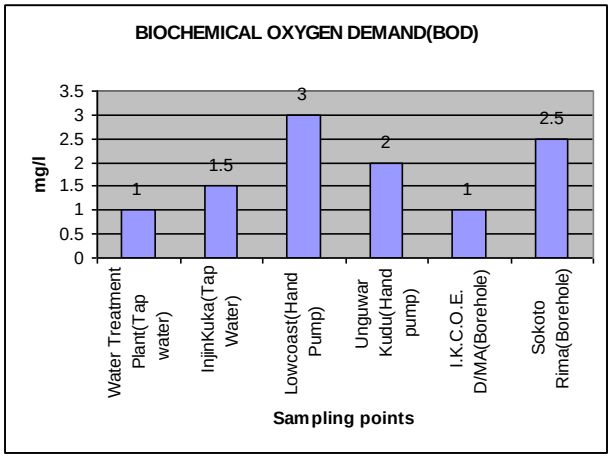


- ***Chemical Oxygen Demand (COD) and Biochemical Oxygen Demand (BOD):*** Higher COD value of (8.00mg/l) was observed in sample 3 (low coast hand pump), moderate concentrations (4.92 to 6.40mg/l) were found in samples 4(Unguwar Kudu hand pump) and 6(Sokoto Rima borehole) and lowest values recorded (3.20 to 4.0mg/l) were found in sample 1(Water treatment plant), 2(Injin Kuka tap water) and 5(Isa Kaita college borehole).
- In the case of BOD values, sample 1(Water treatment plant) and 5(Isa Kaita college borehole) had the lowest BOD values (1.00mg/l), sample 2(Injin Kuka tap water) and 4(Unguwar Kudu borehole) had moderate values of about (1.50 to 2.00mg/l), highest values (2.50to 3.00mg/l) were observed in sample 3(Low cost hand pump) and 6(Sokoto Rima borehole).

Comparisons on chemical oxygen Demand (COD) between the water sources

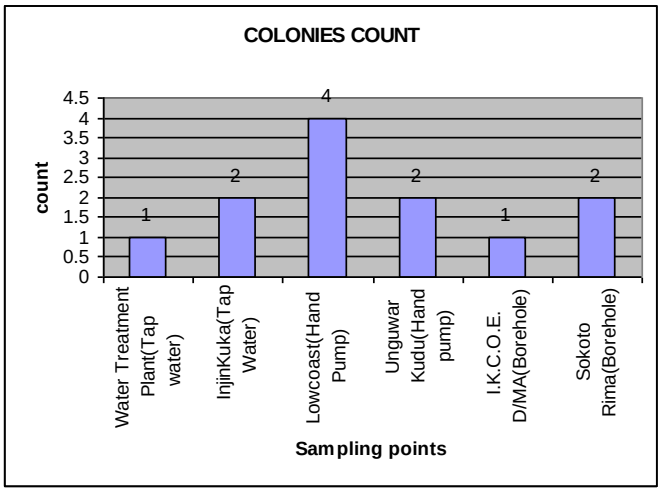


Comparisons on Biochemical oxygen Demand (BOD) between the water sources

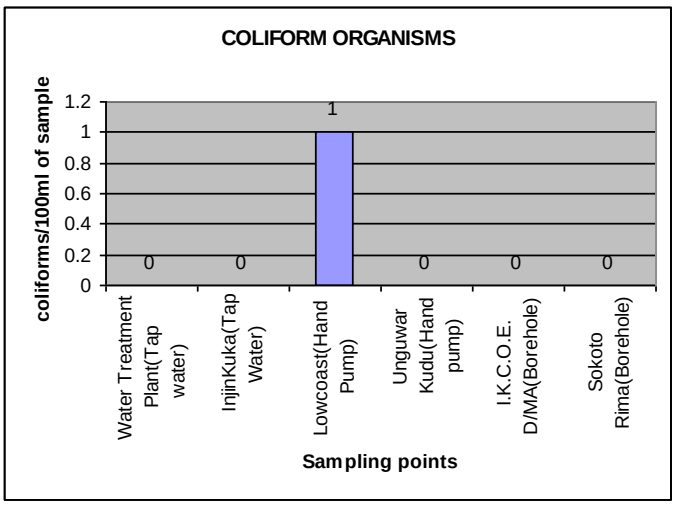


- Colonies count and coliform organisms per 100ml of sample: Colonies of micro organisms counted 4 in sample 3(Low cost hand pump), 2 in sample 2(Injin Kuka tap water), 4(Unguwar Kudu hand pump) and 6(Sokoto Rima borehole) and 1 in sample 1(Water treatment plant) and 5(Isa Kaita college borehole). Coliform organisms were detected only in sample 3 (low cost hand pump), the number of coliforms discovered per 100ml was one (1).

Comparisons on colonies count between the water sources



Comparisons on coliform organisms between the water sources



Comparisons of results obtained with FME (1997) drinking water standards

The results of the parameters tested were presented on table 1, their comparison with FME (1997) drinking water standards explains the nature of individual sources.

- Sample 1 Water Treatment plant (Treated tap): Revealed high concentration of turbidity (4.0NTU) about four times higher than FME (1997) standards. Total suspended solids were found to be (12.67mg/l) slightly above FME's (10mg/l) recommended level. BOD result was (1.00mg/l) slightly higher than the recommended (FME's) standard. Colonies counts were also slightly above the standard. pH value (6.13) was below standard. Other tested parameters were found to be within acceptable portability levels.

- Sample 2 (Injin Kuka Treated Tap): In this sample, all the parameters tested were within the acceptable portability limit except pH (6.1), turbidity (3.66 NTU), total suspended solids (12.66mg/l), BOD 1.50mg/l) and colonies count (2 in 100ml)These parameters, pH exclusive, were all above the recommended FME standards.

- Sample 3 (low coast hand pump): Revealed high concentration of the following parameters above the standards: BOD (3.00mg/l) thrice higher than the standard, colonies count (4 in 100ml) also higher than recommended level and coliform organisms (1 in 100ml). Beside these three parameters, all the results obtained were within the recommended threshold.

- Sample 4 (Unguwar Kudu Hand pump): In this sample, all the tested parameters were found to be within the acceptable portability level except turbidity (3.0 NTU) about thrice higher than standard, colonies count

(2 in 100ml) which was two times higher than standard and BOD (2.00mg/l) also higher than recommended threshold.

- ***Sample 5 (I.K.C.O.E. Borehole***): In the case of Isah Kaita College of Education borehole, only BOD (1.00mg/l) and colonies count (1 in 100ml) were above the standard. All other parameters were generally within the recommended FME standards.

- ***Sample 6 (Sokoto Rima Borehole):*** In sample 6 High concentration of turbidity (2.7 NTU), BOD (2.50 mg/l) and colonies count (2 in 100ml) were detected. Turbidity and BOD were about two and half times higher than the recommended level with colonies count about two times higher than standard. Other ten parameters were found to be within portability levels.

III. RESULTS AND DISCUSSION

Table 1 clearly presented the concentration of parameters tested from the sources of drinking water in the study area. The most frequent detected parameters that were above the recommended portability levels include turbidity, Biochemical oxygen demand and colonies count. Suspended solids were detected in sample 1(Water treatment plant) and 2(Injin Kuka tap water) and coliform organisms were detected only in sample 3 (Low cost hand pump).

According to the data obtained and its comparison with water quality standards set by FME (1997), it was discovered that most of the water sources in the study area were safe for human consumption as discussed below

- In sample one (water treatment plant tap water), it was found that the water source is safe for human consumption on both physical and biological basis, this is because, the physical and biological Parameters tested were found within the recommended FMEs (1997) water quality standard. The only exception was on turbidity, total suspended solid, biochemical oxygen demand and colonies count, these four parameters were slightly above the recommended FME's standard. The occurrence of these parameters at the level stated above could be attributed to the fact that the samples were collected during rainy season when the reservoir is thoroughly mixed with new impurities through run-off.

- With regard to sample two (injin kuka treated tap water), it was discovered that most of the parameters tested were within portability limit. Physically and biologically, the water sources is safe for human consumption, even though, there were slight dominance of turbidity, total suspended solid, biochemical oxygen demand and colony count over the recommended level. The reason for the dominance of these parameters is the same as in sample one above because they are from the same source but at different locations.

- The discovery of one coliform bacteria, biochemical oxygen demand and colonies count at levels higher than recommended FMEs standard have made low coast hand pump unsafe for human consumption on biological ground. But physically the water is safe for human consumption as all physical parameters were found within recommended standard. Rational behind discovery of coliform bacteria and largest number of microbial count in sample 3 is that, the hand pump is sited within low coast housing estate and the houses are characterized with modern toilets that have septic tanks, so the source of water get contaminated through seepage from the septic tanks. In addition to this, there is waste dump side by the side of the hand pump, this also contributes to the contamination of the water.

- Sample 4 Unguwar kudu hand pump was found to be physically safe for human consumption since all the physical parameters with the exception of turbidity are within the portability limit. Biologically, the water is fairly safe as it reveals neither coliform bacteria nor Eschericia coli, but with incidental exhibits of biochemical oxygen demand and colony count at levels slightly higher than recommended standard.

- Sample 5 Isah Kaita College of Education. Borehole was found to be suitable both physically and biologically. All the physical parameters tested were found within acceptable portability level. On biological terms, there were very slight dominance of colony count (1 in 100mls) and BOD (1.00mg/l) over the recommended level.

- With the exception of turbidity (2.7NTU), all physical parameters tested were found to be safe for human consumption in sample 6 (Sokoto Rima Borehole). On biological ground, the source seems safe for human consumption because it contains no faecal contamination

as coliform organism and Eschericia coli were not detected. But revealed BOD (2.50 mg/l) and colony count (2 in 100mls) at limits higher than standard.

IV. CONCLUSION AND RECCOMMENDATION

CONCLUSION

The data obtained at the time of this research and its comparison with FME (1997) water quality standard revealed that most of the water sources in Dutsin-ma town were found to be physically and biologically safe for human consumption, the only exception was on sample 3 (low cost hand pump) being it the only source in which large number of microbial count (4 in 100ml) and coliform (1 in 100ml) were detected. However there were slight dominance of BOD and colony count in all the samples, turbidity in sources 1(Water Treatment Plant),2(Injin Kuka tap water),4(Unguwar Kuduborehole) and 6(Sokoto Rima borehole) and total suspended solids in source1(Water Treatment Plant) and 2(Injin Kuka tap water).

Based on this, it is concluded that, most of the water sources assessed are safe for human consumption and occurrences of water borne diseases cases in the town are not totally connected to poor water quality but also to poor sanitation and poor methods of collection and preservation of water. In respect of this, the following recommendations were offered.

V. RECOMMENDATIONS

- The reservoir supplying water to the treatment plant should be dredged to improve its capacity, because during dry seasons, the level of water in the reservoir falls significantly. There was even a time when the reservoir dried up completely.

-The current water treatment plant laboratory unit should be up graded and adequate water treatment facilities should be provided at all time, so that all suspected water contaminants could be detected and taken care of.

- Efforts should be made to rehabilitate broken down boreholes because at the time of this research few boreholes were functioning. There is also the need for additional boreholes in the town to meet the current water demand, and boreholes should be sited away from septic tanks, pit latrines and waste dump sites, so that the level of ground water contamination through seepage could be minimized.

- Underground water sources found to contain high concentration of contaminants should be treated until quality standards are maintained.

- People should be mobilized on the goodness of water and environment sanitation and to avoid indiscriminate waste disposal along the drainages. This could be carried out by department of water supply and environmental sanitation established recently in the local government.

- There is the need for public health education or awareness through which people get acquainted with water related diseases, their health implication and how to overcome them

VI. REFERENCES

[1]. Ayoade J.O (1988) Tropical hydrology and water resources. London, Macmillan publisher Ltd.

[2]. Balarabe,M.I, Oladimeji,A. A and Abubakar S.M. (1995). Issues in land Administration and Development in Northern Nigeria. Department of Geography, Bayero University Kano.

[3]. Bhatia S.C (2006) Environmental Chemistry. .New Delhi, CBS Publishers and Distribution.

[4]. Federal Ministry of Environment (1997) National Guidelines and Standards for water quality in Nigeria.

[5]. Federal Environmental Protection Agency FEPA (1996). Water Quality Monitoring and Environmental status.

[6]. Garette N (2000). Oxford Advanced Geography. U.K OxfordUniversity Press.

[7]. Kiyawa I. F (2009) An assessment of Domestic water quality forHuman Consumption in Kiyawa Town, Jigawa state.Unpublished Msc thesis Dept. of Geography, Bayerouniversity Kano.

[8]. Maigari A.I (2002). Introduction to Environmental Problems and Management. Kano,

[9]. wa'adallah Environmental Consult (WADEC)

[10]. Tukur R. and Abdulkarim B. (2008). Sustainable water ResourcesManagement; A Tool for National Development. APaper Presented at the first national conferenceorganized by school of art and social sciences. IKCOE Dutsin- ma, Katsina state.

[11]. Uchegbu S.N (2002). Environmental Management and Protection (2ndEdition). Enugu, Spotlite Publishers.