WATER QUALITY ANALYSIS OF BOREHOLES WITHIN LAPAI AND AGAIE LOCAL GOVERMENT AREA OF NIGER STATE
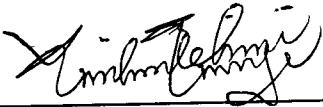
BY

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MATRIC No.: 2006/24131EA

BEING A FINAL YEAR PROJECT REPORT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIRMENTS FOR THE AWARD OF BACHELOR OF ENGINEERING (B. ENG.) DEGREE IN AGRICULTURAL & BIORESOURCES ENGINEERING, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGER STATE
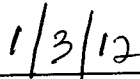
FEBRUARY, 2012.

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DECLERATION

I hereby declare that this project work is a record of a research work that was undertaking and written by me. It has not been presented before for any degree or diploma or certificate at any university or institution. Information derived from personal communication, published and unpublished work were duly referenced in the text.
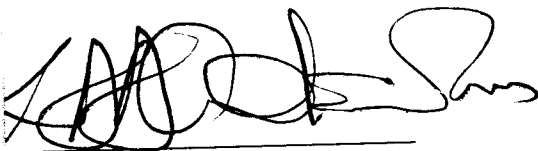
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Olatunji, Timilehin Yinka   Date

CERTIFICATION

his is to certify that the project entitled "Water quality analysis of boreholes within Lapai Local

overnment Area of Niger State" by Olatunji, Timilehin Yinka meets the regulations governing

e award of the degree of Bachelor of Engineering (B. ENG.) of the Federal University of

echnology, Minna, and it is approved for its contribution to scientific knowledge and literary

esentation.

r. Kamoru Adeniran

upervisor

22–02– 2012

Date

ngr. Dr. P. A. Idah

iead of Department

01 /03/2012

Date

:ternal Examiner

22—02—2012

Date

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DEDICATION

This project is dedicated to my loving Mother Mrs. Caroline Folake Olatunji for her unstinting love and unwavering support throughout my five-year course in Agric. and Bio-Resources Engineering.

ACKKNOWLEDGEMENT

First and foremost, I want to appreciate my Lord and personal saviour, Jesus Christ, for his abundant grace in the completion of this Project work.

I also want to recognise the indispensible contributions of my Supervisor, Engr. Dr. Kamoru Adeniran to the success of this work.

My in-depth gratitude goes to my irreplaceable Parents Mr. Femi &Mrs. Folake Olatunji for their love and care. My love also goes to my two winsome sisters, Funmi and Faith Olatunji.

To all my friends and colleagues, too many to be mentioned, for their helps at one time or the other; God bless you all.

My appreciation goes to all the seasoned and well-lettered lecturers that have ever imparted knowledge in me during my years of study in this prestigious institution.

ABSTRACT

An investigation was carried out to asses and analyse the physical, chemical and biological characteristics of borehole water in Lapai and Agaie LGA; and to ascertain if the borehole water meets the WHO (2006) and NIS(2007) requirements and guidelines for drinking-water quality standards. The study sites were located within Lapai and Agaie. These locations are within longitude $6^0 20^0E$, to longitude $6^0 35^0E$. The samples were collected from eight different points: four each from both Agaie and Lapai. The magnesium content in samples A-H tested (7.08, 2.93, 1.22, 6.12, 9.27, 3.42, 20.51 and 106.5 mg/l respectively), with sample H exceeding the acceptable 50mg/l limit. The level of Escherichia Coliform (E. coli) of samples A, B, C D, E, F G and H were 6, 0.0 13, 0, 0, 0, 30 and 52 cfu/100ml respectively. For total coliform, only samples D and F were below the required standard set by WHO and NIS which is 10 cfu/mL. For the other parameters, the borehole samples met the required drinking-water standards. Therefore, only samples D and F fully meets the WHO and NIS drinking-water quality standards. Based on the study on the water samples collected, it was recommended that dumpsites, sewer, septic tanks and feedlot should be at least 100 meters away from borehole water sources and the communities or villages should be enlightened on the effects of contaminated water and should be encouraged to keep their environment clean.

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CHAPTER ONE

1. INTRODUCTION

1.1 Background to the Study

The contamination of drinking water in developing countries has been the subject of many reports. (Feachem, 1983). The contamination of water sources can result to water borne diseases such as typhoid, cholera, diarrhoea and dysentery which can become potentially communicable (Musa, 1996). The quality of borehole water is of vital importance for industrial, irrigation and domestic purposes. Drinking water standards are based on two main criteria:

i.   The presence of objectionable taste, odours and colours and;

ii.   The presence of substances with adverse effects on the quality of available water resources Ako *et al.*, (1990).

The fact that less than 1 per cent of earth's aquatic endowment is fresh water calls for greater management, conservation and a search for alternative source of potable and utilizable water through appropriate water analysis (Carruther and Morrison, 1993).

High-quality water is defined as water that contains no pathogenic organism. It does not contain any chemical concentration that may be physiologically harmful, or economically damaging. It is not corrosive, nor does it leave excessive or undesirable deposits on water-conveying structures and plumbing fixtures.

Criteria used to evaluate the safety of drinking water are continually reassessed as new constituents are identified and health-effect research advances (Schwartz, 2007)

1.2 Statement of Problem

Drinking water sources contaminated with harmful chemical contaminants particularly cadmium, nitrate-nitrogen, sulphate, and bacterial contaminants may bring about diarrheal illnesses (Fauci et al. 1998; Gupta *et al.* 2001).

Over the years, given the prevailing water scarcity, there has been a growing and widespread concern about the safest source of potable accessible water as various health and environmental challenges have arisen from contaminated and unsuitable sources of water supply in Niger State.

1.3 Objectives

The project aims at achieving the following objectives:

(a) To asses and analyse the physical, chemical and biological characteristics of borehole water in Lapai and Agaie LGA;

(b) To ascertain if the borehole water meets the WHO and NIS requirements and guidelines for drinking-water quality standards and;

(c) To provide useful information on how boreholes can be effectively managed to improve the overall performance as a means of water supply.

1.4 Justification

There is little or no awareness about the dangers inherent in contaminated water. It is all in an attempt to direct attention to issues of effective management of the environment and the protection of the water qualities therein. (Campbell, 1993).

It has been established that the continuous consumption of unsafe drinking water directly threatens the health and life of individuals (Sia Su 2005; Semenza *et al.* 1998). Consumption

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of drinking water from unsafe and uncertain sources has indicated various health risks that may include cancer, nephrotoxicity, central nervous system effects, and even cardiovascular diseases (Fauci *et al.* 1998).

This project is therefore justified by the need to determine the physical, chemical and microbial parameters of selected boreholes in Lapai LGA to carry out a comparative analysis of the results with WHO water standards. Hence its safety for public consumption and industrial utility. Also, useful observation and information will be given as to how boreholes can be effectively managed for quality performance.

1.5 Scope of Study

The assessment of the performance and maintenance of boreholes in Lapai Local Government of Niger State. The investigation was carried out in Lapai and Agaie.

1.6 Limitation of Study

The limitation of the study is that the tests were carried out outside the school campus due to lack of instrumentation for the analysis.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 WATER QUALITY STANDARDS

Pure water is a chemical compound with each of its molecule (the smallest unit of a compound) containing two hydrogen atoms and one oxygen atom, and nothing else. (H_2O being the chemical formula for water). However, pure water can never be available in nature. Even a man-made drop of water, prepared in a laboratory by lighting the hydrogen and oxygen gases in a test tube, may not be perfectly pure, because the water drops so formed will dissolve the glasses of the test tube (although a very little bit). The precipitation, in the same manner, at the instant of its formation, contains no impurities, but during the process of formation and falling through the atmosphere, it may dissolve certain gases, traces of minerals, and other substances.(Eddy, 2004). When the precipitation reaches the earth's surface, many more opportunities are present for the introduction of various physical, chemical, or bacterial impurities in it. As the rain water flows over the surface of the earth, it picks up or dissolves particles of soil, garbage, sewage, pesticides, and other human, animal or chemical wastes. It may pick up and dissolve certain decayed organic materials, such as plants or dead animals. As the surface water seeps into the ground-water –reservoir, most of the suspended particles are filtered out, but on the other hand, the water dissolves the minerals and salts present in the earth's layers, through which it travels before joining the water table (Semenza *et al.* 1998)

The impurities which water dissolves or picks up as suspended matter may sometimes make it more useful and potable for public uses and especially for drinking, and sometimes it may render it harmful and unfit. For example, certain minerals such as iron, calcium, magnesium, fluorine, etc in small quantities may be useful and good for the health of the people, because

human being needs a certain amount of these elements in their bodies. But when these materials and others are dissolved in large amounts or in certain combinations, the water may become unfit or less useful for municipal, industrial and other uses. For example, the water may contain toxic or poisonous substances such as arsenic, barium, cadmium, chromium, cyanides, lead, selenium silver, copper, etc, which may be very harmful to the public health, even if present in low quantities Sometimes, the water may contain too much salt, thereby rendering it brackish and making it undrinkable and less useful for cloth washing or for irrigation and farming (Ebong *et al.*2008). Similarly, sometimes, the water may contain harmful bacteria, the presence of which may cause diseases such as cholera, typhoid, dysentery, gastro-enteritis, infectious hepatitis (i.e., jaundice), etc. (Sia Su, 2005)

To ensure safety to public health, economy and utility in industries and other uses, it therefore becomes imperative upon the planners and designers of public water supply schemes to thoroughly check, analyse, and treat the raw available water to safe and permissible limits, before supplying to the public. This is truer and must be strictly adhere to, when water is supplied for municipal uses, such as drinking, bathing, washing, etc. When water is required solely for industries or for irrigation, the quality standard may vary depending upon the requirement of each industry or farming and irrigation. Water required for domestic uses, particularly water required for drinking, must be colourless, odourless, and tasteless. It should be free from turbidity, and excessive or toxic chemical compound. Harmful micro-organisms and radio activity must be absent. The quality of municipal water supplies is generally controlled throughout the world. The World Health Organisation has laid down its standards for potable waters. Different nations also have their standards peculiar to their definitions of water quality (WHO 2006). All water sources intended for human consumption shall comply with Nigerian Standards for Drinking Water Quality, and shall

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receive authorisation from Ministry of Health before being supplied to the population (NEMA, 2003)

2.2   Groundwater

Ground water is found underground in cracks and space in the subsoil in rocks (consolidated or unconsolidated) that are permeable enough to allow usage quantity to move into wells and springs. Locating ground water mean determining where water occurs under condition that permit it to come into well fast enough to be useful. Some practical ways of doing these includes application of scientific knowledge and drilling experience. With the increase in demand for an extra source of water to complement for the inadequacy in water supply, Minna water works can only meet about 50% of the total water requirement of the town so there is a need for geophysical exploration of the area to get useful information about the subsurface structure that could be a guide for ground water development (Sophocleous, 2002).

Water that is held as soil moisture will percolate downward until it reaches zone where all of the open spaces in sediment and rock are completely filled with water, this is the zone of saturation. Water within is called groundwater the upper limit of this zone is known as the water table where the soil, sediment, and rock are not saturated is called the zone of aeration. The unsaturated zone above the water table (the greenish area) still contains water (after all, plants' roots live in this area) (Brady and Weil, 1999).

Typically, Groundwater is water located beneath the ground surface in soil pore spaces and in the fractures of rock formations. A unit of rock or an unconsolidated deposit is called an aquifer when it can yield a usable quantity of water. The depth at which soil pore spaces or fractures and voids in rock become completely saturated with water is called the water table. Groundwater is recharged from, and eventually flows to, the surface naturally; natural

discharge often occurs at springs and seeps, and can form oases or wetlands. Groundwater is also often withdrawn for agricultural, municipal and industrial use by constructing and operating extraction wells. The study of the distribution and movement of groundwater is hydrogeology, also called groundwater hydrology (Birkeland, 1999).

2.3 Characteristics of Water

The raw or treated waters can be checked and analyzed by studying and testing the: Physical characteristics; Chemical characteristics; and Microscopic/ Biological characteristics.

2.3.1 Physical Characteristics

Turbidity

Colour

Taste or odour

Temperature

Specific conductivity

2.3.1.1 Turbidity

If a large amount of suspended matter such as clay, silt or some other finely divided organic materials is present in water, it will appear to be muddy or cloudy or turbid in appearance. The turbidity depends upon the fines and concentration of particles present in water. Although, the clay or other inert suspended particles may not be harmful to health, yet they are to be removed or reduced for aesthetic and psychological reasons. Since people do not like turbid water, the turbidity of raw water must be measured, and then reduced by treatment to permissible values, so as to make it almost invisible under naked eye.

2.3.1.2 Colour

Dissolved organic matter from decaying vegetation or some inorganic materials, such as coloured soils, etc., may impart colour to the water. The excessive growth of algae and aquatic micro-organisms may also sometimes impart colour to the water. The presence of colour in water is not objectionable from health point of view, but may spoil the colour of the clothes being washed in such waters, and is also objectionable from aesthetic and psychological point of view, as people may not like to drink coloured waters. The colour in water can be easily detected by the naked eye. It can be measured by comparing the colour of water sample with other standard glass tubes (called Nessler tubes) (Smith et *al.* 1996)

2.3.1.3 Tastes and Odours

The dissolved organic materials or inorganic salts, or the dissolved gases may impart tastes and odours to the water, which generally occur together. Taste and odour may be caused by the presence of dissolved gases such as H_2S, CH_4, CO_2, O_2, etc., combined with organic matter; mineral substances like $NaCl$, iron compounds, carbonates and sulphates of other elements. Some tastes, such as those imparted by dissolved oxygen and dissolved CO_2 are generally desirable. Evidently, for drinking purposes, the water must not contain any undesirable or objectionable taste or odour. In order to remove the taste & odour from the raw water, the chemical composition of water must first be ascertained, so as to determine as to what treatment, if any, is required to make its taste and odour acceptable for domestic use. The extent of taste or odour present in a particular sample of water is measured by the term called odour intensity, which is related with the threshold odour. The threshold odour number represents the dilution ratio at which the odour is hardly detected. For public supplies, the water should generally be free from odour. The threshold number should be 1 and not more than 3. (Eddy, 2004)

2.3.1.4 Specific Conductivity of water

The total amount of dissolved salts present in water can easily estimated by measuring the specific conductivity of water. The specific conductivity of water is determined by means of a portable ionic water tester and is expressed in micro-ohms per cm at $25^{\circ}C$. The specific conductivity of water is multiplied by a coefficient (generally 0.65) so as to directly obtain the dissolved salt content in mg/l. The exact value of this coefficient depends upon the type of salts present in water (Forstner and Wittman, 1983)

2.3.2 Chemical Characteristics

Chemical analysis of water is carried out in order to determine the chemical characteristics of water. This involves test for determining the following: Total solids and suspended solids, pH value, Hardness, Chloride content, Nitrogen content, Iron, Manganese and other metal contents, Dissolved gases.

2.3.2.1 Total Solids and Suspended Solids

The total amount of solids (suspended as well as dissolved solids) present in water can be determined by evaporating a sample of water and weighing the dry residues left. The suspended solids can be found by filtering the water sample and weighing the residue on the filter paper. The difference between the total solids and the suspended solids will then represent nothing but the dissolved solids. (Note that the dissolved solids can also be estimated by physical analysis by determining the specific conductivity of water) (Wrensh, 1990)

2.3.2.2 pH values of water

The pH value of water indicates the logarithm of reciprocal of hydrogen ion concentration present in water. It is thus the indicator of the acidity or the alkalinity of water. Since the pH

is the log of reciprocal of H^+, the higher values of pH means lower hydrogen ion concentration, and thus represent alkaline solution; whereas, the lower values of pH means higher hydrogen ion concentration representing acidic solutions (Sanders, 1982)

2.3.2.3 Hardness of water

Hardness in water is that characteristic which prevents the formation of sufficient leather or foam, when such hard water is mixed with soap. It is usually caused by the presence of Calcium and Magnesium salt in the water, which form scum by reaction with soap. Hard waters are undesirable because they may lead to greater soap consumption, scaling of boilers, causing corrosion and incrustation of pipes, making food tasteless, etc. *Temporary hardness or carbonate hardness*: If bicarbonates or carbonates of calcium and magnesium are present in water, the water is rendered hard temporarily, as this hardness can be removed to some extent by simple boiling or to full extent by adding lime to the water. When such water is boiled, CO_2 escapes out and the insoluble calcium carbonate gets precipitated. (Wrensh ,1990)

Permanent or non-carbonate hardness: If sulphate, chlorides and nitrates of calcium or magnesium are present in water, they cannot be removed al all by simple boiling, and therefore, such water requires special treatment for softening. (Wrensh ,1990)

2.3.2.4 Chloride content

Chlorides are generally present in water in the form of sodium chloride (common salt) and may be due to leaching of marine sedimentary deposits, pollution from sea water, brine or industrial and domestic wastes, etc. Their concentrations above 250 mg/l produce a noticeable salty taste in drinking water and are thus objectionable. (Sommer and Horwitz , 2001)

2.3.2.5 Nitrogen content

The presence of nitrogen in water is an indication of the presence of the organic matter, and may occur in one or more of the following forms:Free ammonia; Albuminoidal or Organic nitrogen;Nitrites; and Nitrates. (Sommer and Horwitz , 2001)

The free ammonia indicates the very first stage of decomposition of organic matter (thus indicating recent pollution); Albumnoid nitrogen indicates the quantity of nitrogen present in water before the decomposition of organic matter has started; the nitrites indicate the presence of partly decomposed (not fully oxidised) organic matter; and Nitrate indicate the presence of fully oxidized organic matter in water (thus representing old pollution). The presence of free ammonia in water indicates the presence of un-decomposed organic matter, and for potable waters, it values should not exceed 0.15 mg/l. It can be easily measured by simply boiling the water and measuring the liberated ammonia gas, by distillation process. The very presence or organic nitrogen in water indicates pollution, and for potable waters, it should not exceed a value of about 0.3 mg/l.

It can be easily measured by adding strong alkaline solution of potassium permanganate (KMnO4) to already boiled water sample and again boiling the same, when ammonia gas is liberated. The partly oxidized organic matter present in water in the form of nitrites is highly dangerous and, therefore, the permissible amount of nitrites present in potable water should be nil. The nitrate, on the other hand, represents the fully oxidized organic matter, and such waters may not be harmful. However, the presence of too much of nitrate in water may adversely affect the health of infants, causing a disease commonly called blue baby disease. Children suffering from this disease may vomit; their skin colour may become dark, and may die in extreme cases. The nitrate concentration in domestic water supplies is generally limited to 45 mg/l (Feachem, 1983)

2.3.2.6 Metals and other chemical substances

Tests are carried out in order to determine the amount of various metals and other substances such as iron, manganese, copper, lead, barium, cadmium, arsenic, selenium, fluorine, etc., present in water. The amount of these minerals or metals in potable water is to be limited to their permissible standard values so as to avoid their harmful effects on human life. (Eddy, 2004).

2.3.2.7 Dissolved Gases

The various gases which may get dissolved in water due to its contact with the atmosphere or the ground surface may be: nitrogen, methane, hydrogen sulphide, carbon dioxide, and Oxygen.

Hydrogen sulphide gas (H_2S), if present in small amounts, may give bad taste and odour to the water, and should therefore be removed. Presence of CO_2 indicates biological activity. It may impart bad taste and odour to the water and may also cause corrosion. Oxygen gas is generally absorbed by water from the atmosphere, but is being consumed by unstable organic matter for their oxidation. If the oxygen present in water is found to be less than its saturation level, it indicates presence or organic matter and consequently making the water suspicious (Silvidher, 1986)

2.3.2.8 Biochemical Oxygen Demand (BOD)

The amount of oxygen required in the process until oxidation gets completed is known as BOD. Polluted water will continue to absorb oxygen for many months, till the oxidation gets completed, and it is not practically possible to determine this ultimate oxygen demand.. The difference between the original oxygen content and the residual oxygen content will indicate the oxygen consumed by the water sample in five days. The extent of pollution of sewage and

other industrial waste is also measured by determining the values of their BOD (Campbell, 1993)

2.3.3 Bacterial and Microscopic Characteristics

The Most of the bacteria present in water require oxygen for their survival. These bacteria consume dissolved oxygen from the water and decompose the refuse and organic matter present in water, thus doing their cleaning-up job. However, there are other bacteria that produce fatal diseases. Although, these harmful pathogenic bacteria can be tested and counted in the laboratories, it is costly, lengthy and complicated, and is therefore not carried out on routinely basis when testing for water quality. The usual routine tests are however generally conducted only to detect and count the presence of non-pathogenic indicator organisms, particularly the coliform group (total coliform and faecal coliforms (Feachem, 1983).

2.4 Risk of underground pollution

Groundwater pollution from human activities has become a major topic of groundwater research and large amounts of money are currently being invested in the prevention of groundwater pollution and in the rehabilitation of polluted groundwater bodies. The contaminants that may pollute groundwater are grouped according to their physic-chemical characteristics in order to characterise their fate in the groundwater environment:

    i.   Metals

    ii.   Dissolved organics

    iii.   Non-aqueous phase liquids (NAPLS)

    iv.   Bacteria and viruses

(i) Metals

Dissolved metals usually occur as cations in groundwater, but the important excerptions exist such as chromium and uranium, which may also occur as oxy-anions. The mobility of metal cations often increases with decreasing pH, for a combination of two reasons. Firstly, most minerals that are formed by metals are less soluble at increasing pH: carbonates, oxyhydroxides, and sulphides. Secondly, the sorption capacity of solid phases for the cations increases with increasng pH (Adefemi and Awokunmi, 2009).

(ii) Dissolved Organics

Dissolved organics are relevant in the groundwater environment in two different ways. First, dissolved organic matter may be a reductant of of the groundwater system, i.e. its decomposition brings about anaerobic conditions in the groundwater. Second, organic molecules may be undesirable in groundwater because of their toxicity. The first condition is normally indicated by the concentration of Dissolved Organic Carbon(DOC) and refers to organic matter as a major contributor to the overall groundwater composition. The latter refers to individual organic species at low concentrations and these species are referred to as micro-organics Examples are pesticides, polycyclic aromatic hydrocarbons and chlorinated aliphatic hydrocarbons. (Daniel, 1999)

(iii) Non-aqueous phase liquids

Following spills on the surface, Non-aqueous may occur as immiscible fluids in the subsurface. The flow of these liquids is hydrodynamically controlled not geochemically. Their behaviour depends on their density; fluids like petrol, diesel, etc. Are lighter than water and form floating layers. On the other hand several solvent fluids like trichloroethane are

heavier and form sinking layers. Benzene, Toluene, ethylbenzene and xylene, for example, are compound in oil that shows relatively high mobility in groundwater. (Musa, 1996)

(iV) Bacteria and Viruses

Bacteria and viruses may cause disease if contaminated water is used for drinking. These bacteria are referred to as pathogenic bacteria. The contamination is often related to sewage or waste water. Survival of viruses is favoured by high moisture contents and low temperatures. The mobility of bacteria and viruses is largely determined by the same factors. Greatest movements occur in coarse aquifers and infiltration areas with thin unsaturated zones. Fractured rock has the highest potential risk. Contamination by bacteria or viruses is often local, for similar reasons to colloidal-facilitated radionuclide transport (Adefemi and Awokunmi , 2009).

2.5 Groundwater Contamination

The pollution of groundwater is a serious matter, particular in areas aquifers provide a large part of water supply. One common source of groundwater pollution is sewage; its source includes an ever increasing number of septic tanks, as well as inadequate or broken sewer system and farms waste. Regardless of the source (surface or underground) water polluted by either excessive chemical constitute or faecal materials become potential agent or typhoid and paratyphoid fevers, dysentery, cholera and vital disease e.g. Hepatitis (Feachem, 1983). According to Saxena (1977), there exist a relationship between groundwater pollution of an area and open refuse dumps. They also mentioned that street refuse depositions amongst other factors like land erosion, wet and dry atmosphere deposition is a source of storm water run-off pollution which invariably ends in the ground. In another literature, Raesner and Walesh (1988) claim that a urban run-off contributes tones of nutrients and pollutants to receiving water in year (groundwater inclusive)

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Slividher (1986) observed heavy metal concentration in solid waste leach out chemical compound from dumped waste, which eventually percolated into the soil to mix groundwater. This often results to groundwater of adulterated quality. Another great factor which affects groundwater quality in the soil and rock formation for which water is source.

2.5.1 Sources of Water Contaminant in Groundwater

All water is susceptible to contamination it may accumulate contaminants from the air, ground or from rocks. Groundwater contamination when man-made substances, or in some naturally occurring substance are dissolved in water recharging the groundwater zone source of contamination include storage tanks, hazardous waste sites uncontrolled landfills septic system and both legal and discharges to the environment. These contaminations include the chemicals found in gasoline oil and road salt and can cause groundwater to become unsafe for human consumption. Also, gasoline components such as benzene, will tend to say in the air packet in the soil (Charles, 2002)

2.5.1.1 Leaking Storage Tanks

Tanks are widely used to store fuels and chemicals, and many of these have leaked over the years. Underground tanks have caused the most contamination, because they can leak slowly for a long time without being discovered. The most common tank sources are gas tanks at filling stations, and fuel and solvent storage tanks at industrial facilities. Most tanks installed before the 1970s were bare steel tanks that tended to corrode. Many of these tanks and their associated piping eventually sprang leaks when corrosions. (EPA, 1988)

2.5.1.2 Septic Systems

Septic systems for subsurface disposal of human wastewater are the rule in more rural areas not served by sewers and sewage treatment systems. Most septic systems serve a single

household, but some larger systems serve a cluster of homes and/ or offices. A typical septic systems starts in the series if drainpipes in a home's plumbing system. These all connect and drain to one pipe that runs outside to a buried septic tank, where solids settle and are trapped. The tank needs to be pumped out periodically to remove accumulated solids. (Adefemi and Awokunmi, 2009)

Umekuka and Mba (1999) reported that poor management of refuse has caused traffic delays in some strategic parts of our urban centers. Waste handling facilities are lacking in many highly populated areas in most developing and under developed countries including Nigeria due to cost and lack of proper planning. The impact on man would be felt if waste metals enter into the food chain and accumulate in living organism (Altundogan et al., 1998). Wastewater contains dissolved organic compounds that fuel redox reactions in the microbes that live in the system. Redox reactions in the tank are usually anaerobic, including fermentation, methane generation, and sulphate reduction . In most septic systems, nitrate is the only groundwater contaminant of concern. Some septic system designs include another anaerobic zone beyond the aerobic zone in the leaching field, where denitrification reduces nitrate concentrations in the effluent (Robertson and Cherry, 1995,)

2.5.1.3 Organic Contaminants

A large portion of all groundwater contamination problems involve organic contaminants. We use vast quantities of hydrocarbon fuels, solvents, and other organic liquids and it should come as no surprise that frequently spilled into the subsurface. Some releases were intentional, many of them perfectly legal because there used to be little or no regulation of waste disposal. (Ebong *et al.* 2008)

Table 2.1: Physical, Chemical and Biological Standards for Drinking Water

S/No	Parameters	WHO Acceptable	Permissible (maximum) limit	NIS	FAO
1	Turbidity(NTU)	1.0	10	5.00	5.00
2	Odor (Unit on platinum cobalt scale)	5.0	25		
3	Color	Unobjectionable	unobjectionable	15.00	
4	pH	6.5 to 8.5	<6.5 or >9.2	6.5-8.5	6.5-8.4
5	Temperature (^{0}C)	-		Ambient	
6	Conductivity (μs/m)	1400	1400	1000	
7	Potassium (mg/l)	55			0-2
8	Total dissolved solids(mg/l)	500	2000	500	450
9	Total hardness (as CaCO$_3$) (mg/l)	200	600	200.00	
10	Chlorides (as Cl) (mg/l)	200	1000	250.00	
11	Sulphate (as SO$_4$) (mg/l)	200	400	200.00	
12	Fluoride (as F) (mg/l)	1.0	1.5	1.50	
13	Nitrate (NO$_3$) (mg/l)	45	45	50.00	
14	Calcium (Ca) (mg/l)	75	200		
15	Magnessium (Mg) (mg/l)	50	150	50	0-50
16	Iron (Fe) (mg/l)	0.1	1.0	0.30	5.00
17	Manganese (Mn) (mg/l)	0.05	0.5		0.2
18	Copper (Cu) (mg/l)	0.05	1.5	1.00	0.2
19	Alkalinity (mg/l)	200	600		
20	Zinc (Zn) (mg/l)	5.0	15.0	3.00	0.2
21	Aluminium (Al) (mg/l)	0.03	0.2	0.20	
22	Bicarbonate (mg/l)	varies			
23	HCO$_3$ (mg/l)	1000			
24	E. coli (or thermotolerant bacteria) (Cfu/100ml)	0	10	0	
25	Total Coliform	0	10	10	

Sources: WHO (2006), NIS (2007), FAO (1985)

2.6 Minimum Separation Distances

When drilling or constructing a bore within a Water Control District, Bore Construction Permit holders must uphold the following condition from the Terms and Conditions of the Permit, that is Separation distance from any obvious pollution sources such as; the closest part of any septic tank effluent trench, fertilizer storage, chemical storage, packing sheds, plant workshops, and animal enclosures must be a minimum of 100m (FEPA/FMENV, 1991).

CHAPTER THREE

3.0 MATERIALS AND METHOD

3.1 Study Area

Location: The study area is Lapai LGA. The 8 borehole locations are within longitude $6^0 20^0E$, to longitude $6^0 35^0E$.
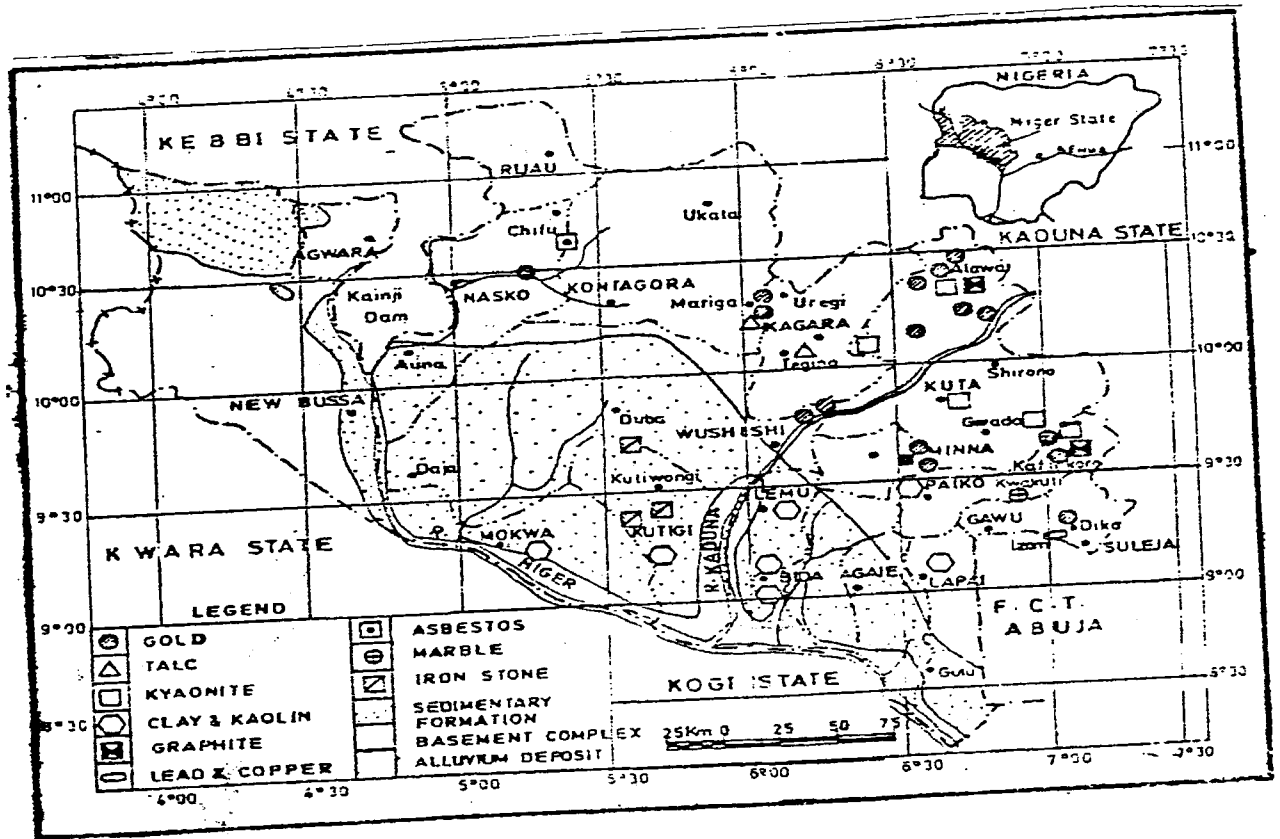

Figure 3.1: Showing the Map of the study area(www.google.com/wikipedia,2011)

Climate and vegetation: The total annual rainfall spreads over the month of April to October with highest month being August, the sum annual rainfall is 1038.3 – 1423.4mm and the mean annual temperature ranges between 32^0 and 29^0 during the dry season. (www.onlinenigeria.com, 2011)

Relief: The relief of the study area is similar to the topography of most of the northern parts of Nigeria. It is not predominantly undulating relief; rather it is mostly flat-lying land with some sparsely distributed hills. *(Adesoye, 1986).*

3.2 materials and sample collection

The samples were collected from eight different points: four each from both Agaie and Lapai. The samples were collected using new thoroughly washed and sterilized bottles. These bottles were washed with distilled water and air dried to ensure accurate results.

Apparatus: The various devices used during the water analysis process include:

Steel tape, global positioning system (GPS), water drawer, Thermometer, sterilized bottles, glass bottles, aluminum foil, spectrophotometer, Curette cork, conductimeter, color comparator, incubator, autoclave, McCarthy bottles, Bunsen burner, sterile needle and syringe (5ml and 10ml), measuring cylinder, distilled water, conical flask, geographical map, beaker, oven, cell plate, nitraver 5, nitriver 3, sulfaver 4, ferrover iron ferroxine, aluver 3, thiocyanate, SPADN.

Table 3.1 A brief explanation of some of these devices and their uses during the water analysis.

Device	Uses
Steel Tape	To measure distances of wells from other physical features around it, also used to determine the depth, diameter and head of the water well.
Global Positioning System (GPS)	To obtain the location of the boreholes.
Thermometer	To obtain the temperature of the samples.
Sterilized Bottle	Used to collect samples for bacteriological test analysis.
Glass Bottle	For collection of water samples needed for laboratory tests.
Aluminum Foil	To cover the rim of the bottle, especially those used for bacteriological analysis.
Spectrophotometer	Used to obtain values of physical and chemical parameters of water samples.
Color Comparator	To obtain color value of water samples
Autoclave	Used to sterilize all metallic and glass materials used for the water analysis.
Incubator	For chemical and bacteriological analysis of samples.
Sterilized Needle and Syringe	Used in titration process of the chemical analysis of water samples.
Measuring Cylinder	To measure volume of water sample.
Conical Flask	Used in mixture of sample solutions.
Cell Plates	Used during bacteriological test for coliform count.
Oven	Used in the sterilization of petridish can, glass ware, and scalpels.
SPADN	This is a reagent used in the test for fluoride.

3.3 Sample location and description

Samples	Location	description
A	Agaie	11.4m to dumpsite
B	Lapai	10m to water log
C	Agaie	33.2m to feedlot
D	Lapai	No water log and dumpsite
E and F	Lapai	15m to metallic waste
G and H	Agaie	2.2m to animal waste

3.4 Brief description of the DR/2000 spectrophotometer

The DR/2000 spectrophotometer is a microprocessor-controlled, single-beam instrument suitable for colorimetric testing in the laboratory or the field. The instrument is pre-calibrated for over 120 different colorimetric measurements and has provisions for user entered calibrations as well as future Hach methods.

Test results can be displayed in percent transmittance, absorbance or concentration in the appropriate units of measure. The instrument offers automatic ranging in the pre-programmed parameters, operated-selected languages, full prompting during testing and error messages for procedural or instrument troubleshooting. A built-in timer helps the operator observe specific reaction times called for in the test procedures by having the appropriate times programmed into the calibration data for that test. The timer can also be used manually by the operator independent of stored methods. RS232 interface capability allows an external printer or computer to interface with the spectrophotometer, and a 0 to 1-volt analog output is provided for a recorder.

The spectrophotometer can operate on battery power, pr AC line power using the battery eliminator/charger unit supplied with accessories. The battery holder supplied holds six D-size dry cells that will power the instrument for approximately 100 tests. An optional rechargeable battery is available, and it can be recharged with the optional battery

eliminator/charger. The eliminator/charger cannot be used to charge D-size, rechargeable batteries.
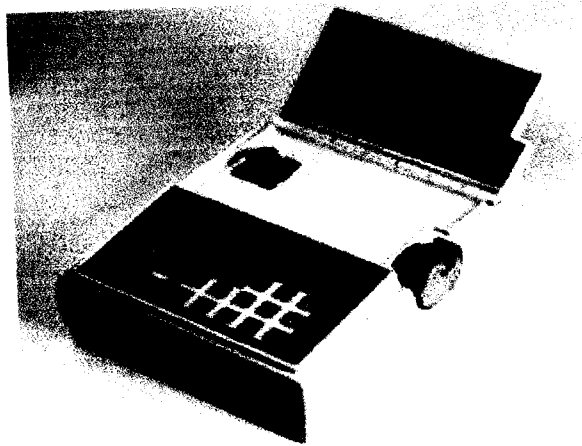

Fig. 3.2 Hach DR/2000 Spectrophotometer
(www.google.com, 20011)

3.5 Sample Analysis

Colour Determination

Using spectrometer, the stored program number (120) for true colour was centered. "Read/Enter" was then pressed and Dial nm455. The nub of the wave length dialled was rotated until the small display showed 455nm then "Read/Enter" was pressed. The display showed platinum cobalt (P_tC_o). A sample cell (the blank) was filled with 25ml of deioized water. The blank was placed into the cell holder. The light shield was closed. "zero" was pressed. The display showed "Wait" and then O. Units PtCo colour was shown. The water sample (A) from clay pot, which was measured into a cell, was placed into the holder. The light shield was closed, "Read/Enter" was pressed, and the display showed "wait" and then the result platinum cobalt units was displayed. When the display stabilised, the result was recorded.

turbidity developed unifying the presence of sulphate. "Shift timer" was pressed. A 5 minutes reaction period began. The cell was allowed to stand undisturbed. When the timer beeps, the display showed: mg/l SO_4^{2-}. A second sample cell was filled with 25ml of sample (the bank). The blank was placed into the cell holder. The light shield was closed. "Read/Enter" was pressed. The display showed "Wait". Then the result in mg/l SO_4^{2-} was displayed. Same procedure was done for the samples.

Determination of Chloride

100ml of the sample and Mercuric Nitrate $(Hg(NO_3)_2)$titration cartridge corresponding to the volume of sample was selected. A clean delivery tube was inserted into the titration cartridge. Digital titrator with the cartridge tip was pointed up. Delivery knob was turned to eject air and the display showed: "Wait". Then the result in mg/l Cl as Chloride was displayed. The other Samples were equally determined.

Determination of Total Hardness, Magnesium and Calcium

100ml water sample was poured into 100ml graduated mixing cylinder. 1.0ml of calcium and magnesium indicator solution using a 1.0ml measuring dropper was added. It was inverted several times to mix. 25ml of solution was poured to each of the sample cells. One drop of 1M EDTA solution was added to one cell (the blank). It was swirled to mix. A stored programme number for magnesium was entered. 225 "Read/Enter" was pressed. For units of mg/l mg as $CaCO_3$. The display showed mg/l $CaCO_3$. The display showed "Dial" nm to 522. The wave length dial was rotated until the small display shows: 522nm. "Read/Enter" was pressed. The display showed mg/l $CaCO_3$ mg. The blank was placed in the cell holder. The light shield was close, Zero was pressed. The display showed "Wait" the 0.00mg/l $CaCO_3$ mg. The light shield was closed. "Read/Enter" was pressed, the display showed "Wait". CONTTG/METD was pressed two times. A store programme number for calcium was

entered. 220 "Read/Enter" for units of mg/l Ca as CaCO₃ Ca. Zero was pressed. The

displayed showed "Wait". Then the result in mg/l Ca as CaCO₃ was displayed.

NOTE: mg/l hardness= mg/l Ca as CaCO₃ + mg/l as CaCO₃

Determination of Iron Content

The stored program number for iron (Fe), ferrover powder pillows was entered. The

wavelength dialled was rotated until the display showed. 510nm. "Read/Enter" was pressed.

The display showed mg/l Fe Fr. A cell with 25ml of samples was filled. The contents of one

ferrover iron reagents iron powder pillow was added to the sample cell (the prepared sample)

and swirled to mix. An orange colour indicates the presence of iron. SHIFT timer was

pressed. A 3-minutes reaction period began. When the timer beeps, the display showed: mg/l

Fe Fr.

Another sample cell (the blank) was filled with 25ml of sample. The blank was placed into

the cell holder. The light shield was closed. Zero was pressed. The display showed "Wait".

Then: 0.00mg/l Fe Fr. Within thirty minutes after the timer beeped, the prepared sample was

placed into the cell holder. The light shield was closed. "Read/Enter" was pressed. The

display showed "Wait". Then the result in mg/l iron was displayed. Same was done for the

remaining samples.

Determination of Phosphorous as Phosphate

The value of phosphate was determined with wavelength 890nm. A clean sample cell was

filled with 25ml of sample and the content of one phosver 3 phosphate powder pillows was

added to the sample cell 9(the prepared sample) and was swirled to dissolve. After 2 minutes

reaction, the second sample cell was filled with 35ml of the blank. The blank was placed into

cell holder and light shield was closed, the equipment was set to 0.00mg/l PO_4^{2-} displayed and the values were recorded. Same procedure was done for the other samples.

Determination of Conductivity

The conductivity/TDS meter was switched on by pressing the appropriate button. The probe was immersed in a beaker containing the deioinized water to rinse the probe. The probe was immersed in the beaker containing the sample A. The probe was immersed beyond the vent holes. The reading was recorded in micro-Siemens/cm. same procedure was done followed for Sample A and B

Determination of Copper

The stored programme number for copper (Cu), copper powder pillows was entered. 135 "Read/Enter" was pressed. The display showed "Dial" nm to 560. The wavelength dialled was rotated until the small display showed 560nm. "Read/Enter" was pressed. The display showed mg/l Cu. A sample cell was filled with 25ml of sample and the content of copper reagent powder pillow was added to the sample cell (the sample prepared) and swirled to mix. "Shift/Timer" was pressed and a 2 minutes reaction period began. The timer beeped and display showed mg/l Cu. The second sample cell (the blank) was filled with 25ml of sample cell placed in a cell holder. Zero was pressed then 0.00mg/l Cu was displayed. Within 30 minutes after timer beeped, a prepared sample was placed in a cell holder. "Read/Enter" was pressed then result in mg/l copper was displayed.

Determination of Nitrate

The stored programme number for low range nitrite nitrogen (NO_2-N) powder pillow was entered. 371 "Read/Enter" was pressed, the display showed "Dial" nm to 507. The wavelength was rotated until small display showed 507nm. "Read/Enter" was pressed and the

display showed mg/l. A sample cell was filled with 25ml of sample. The content of one nitriver 3 Nitrite reagent powder was added (the prepared sample) a stopper was used to cover the lid and shake to dissolve. "Shift/Timer" was pressed. A 15 minutes reaction began. When the timer beeped the displayed mg/l NO_2-L. A second sample cell was filled with 25ml of sample (the blank) and was placed into the cell holder. "Zero" was pressed. Display showed "Wait" the 0.00mg/l NO_2-L. The stopper was removed from the prepared sample then placed into the cell holder. "Read/Enter" was pressed and the display showed WAIT then the result in mg/l nitrite was expressed as Nitrogen (NO_2-N)

Procedures of Bacteriological Analysis

Most portable method was used

i. To detect the presence of coliform in the water samples

ii. To the presence of faecal coliform

Procedure

i. Set of three separate series of three of group was set up, with the total number of mine test tube per sample.

ii. The samples were labelled to water sample and volume of inoculated. The tubes were incubated at 37°C for 48 hours.

iii. For each of the samples, 3 tubes of double strength + 1.0ml of sample and 3 tubes of single strength +0.1ml of sample were added.

iv. The water samples were mixed by shaking thoroughly. Flame bottle, and using a 10ml aliquots to the tubes. Flame bottle and using a 0.1ml a 1ml of water to the three tube 1ml. Flame bottle and using a o.1 ml pipette transfer 0.1ml of water to

the three tube 1ml. Flame bottle and using 0.1 ml pipette transfer 0.1 ml of water

to the three tubes. Incubate all tube 48 hours.

CHAPTER FOUR

4.0   RESULT AND DISCUSSION

4.1   PRESENTATION OF RESULT

Parameters	Unit	Sample A	Sample B	Sample C	Sample D	Sample E	Sample F	Sample G	Sample H
Sulphate	mg/L	5	0.0	0.0	1	2	0.0	12	45
Chloride	mg/L	16.99	31.49	117	28.99	18.99	24.49	65.97	111.5
Magnesium	mg/L	7.08	2.93	1.22	6.12	9.27	3.42	20.51	106.5
Calcium	mg/l	9.63	15.24	2.01	0.43	28.48	8.42	28.88	26.07
Iron	mg/L	0.1	0.015	0.01	0.12	0.015	0.01	0.05	0.00
Sodium	mg/L	7	8	1.5	9.5	10	7.5	23.5	42
Potassium	mg/L	2.68	2.68	0.67	3.35	3.35	1.34	5.36	35.51
Nitrite	mg/L	0.005	0.005	0.005	0.005	0.005	0.00	0.005	0.005
pH		6.80	6.01	6.62	7.68	6.63	6.36	7.14	8.47
Elec. Cond.	µS/m	122	163	13	160	268	125	529	1113
TDS	mg/L	81.74	109.2	8.71	107.2	179.6	83.8	354.4	754.7
D. Oxygen	mg/L	11.47	12.13	7.53	7.04	10.15	11.74	13.09	12.46
Alkalinity	mg/L	34	28	6	35	70	32	55	172
Hardness	mg/L	53.1	50	10	51.1	109.1	35.0	156.1	501.5
Nitrate	mg/L	0.54	0.0	0.0	3.22	0.54	0.00	1.07	1.07
Ammonia	mg/L	0.12	0.00	0.00	0.73	0.12	0.00	0.24	0.24
Turbidity	NTU	13.91	2.41	2.81	39.0	24.9	1.25	7.95	1.13
Colour	NTU	10	3	2	12	11	1.01	3.4	1.11
E-Coli	cfu/100mL	6	0.0	13	0	0	0	30	52
T. Coliform	cfu/mL	102	14	92	3	26	9	164	194

4.2   DISCUSSION

4.2.1 Physical Analysis of Result

This include the determination of water colour, taste and odour, turbidity and other physical factors capable of impairing the quality of water such as total solids contained in the water.

i.   Colour

Basically, colours that are found in water samples originate from impurities such as iron, manganese, dye, humus and vegetables. All the samples analysed meet the WHO and NIS drinking water requirement of 15 NTU. The excessive growth of algae and aquatic micro-organisms may also sometimes impart colour to the water. The presence of colour in water is not objectionable from health point of view, but may spoil the colour of the clothes being washed in such waters, and is also objectionable from aesthetic and psychological point of view, as people may not like to drink coloured waters.

ii.   pH

All the samples fall within the allowable concentration established by NIS and WHO which ranges between 6.5 – 8.5 except samples B and F with a pH of 6.01 and 6.36 respectively.

iii.   Turbidity

The turbidity of the water samples B, C, F, and H (2.41, 2.81, 1.25 and 1.13 NTU respectively) meet the WHO and NIS standards of 5 NTU. However, samples A, D, E and G show elevation above the required standard. Turbidity generally refers to cloudiness caused by very small particles of silt, clay and other substances suspended in the water. It is one of the impurities that are of public health

concern. Even a slight degree of turbidity in drinking water is objectionable to most people. Turbidity also interferes with disinfection by creating a possible shield for pathogenic organisms.

4.2.2 Chemical Analysis of Result

The result of the chemical examination of all the samples tested is discussed below. It should be noted that raised concentration of any chemical known to have an impact on human health may lead to long-term problem.

i.   Total dissolved solid

The total solid in all samples (81.74, 109.2, 8.71, 107.2, 179.6, 83.8, 354.4, 754.7 mg/l) meet the maximum acceptable standard WHO (1000 mg/l) and NIS (500mg/l). Total solid is a quantitative measure of the sum total of dissolved organic and inorganic solutes in water.

ii.   Iron

The iron concentration in all samples did meet the WHO and NIS recommended standard (0.05-0.3mg/l). It increased from 0.00mg/l in Sample H to 0.12mg/l in sample D. Iron affects portability of water and is scale-forming; most common form is ferrous carbonate. Iron can be held in colloidal suspension or in solution by organic matter.

iii.   Sulphate

Sulphate is a substance that occurs naturally in drinking water. The sulphate in the water samples A, B, C, D, E, F, G and H (5, 0.0, 0.0, 1, 2, 0.0, 12, 45mg/l) meet the acceptable standard of 200mg/l set by WHO and NIS. A high concentration of sulphates may produce laxative effect on human system.

iv.   The magnesium

The magnesium content in samples A-G tested (7.08, 2.93, 1.22, 6.12, 9.27, 3.42, 20.51 mg/l respectively) are within the maximum acceptable standard of 50 mg/l, prescribed by WHO and the maximum allowable concentration (30mg/l) set by NIS. However, Sample H, which tested 106.5 mg/l, was above the required standard.

v.   Chloride

The chloride content in the water samples are 16.99, 31.49, 117, 28.99, 18.99, 24.4, 65.97 and 111.5 mg/l for Samples A-H respectively which falls below the WHO and NIS maximum acceptable standard of 200mg/l. Chlorides are usually present in water in the form of sodium chloride (common salt) and magnesium chloride ($MgCl_2$). It can be extremely corrosive as its molecular size is such that it can penetrate the protective oxide-metal interface and react with steel structures.

vi.   Nitrate

Nitrate is present in the natural drinking and waste water. It enters water supplies from the breakdown of natural vegetation, use of chemical fertilizers and from oxidation of nitrogen compound in sewage effluent and industrial waste. The presence of Nitrate in water indicates that the organic matter in the water in partially decomposed or oxidized. For all samples tested, the amount of Nitrate present in the water was within the 45mg/l acceptable WHO standard and the NIS standard of 50mg/l.

vii.   Nitrite

Samples A, B, C, D, E, G and H all tested 0.005 while Sample F tested 0.00 of nitrite value. These all fell below the standard permissible value of NIS and WHO

of 0.2mg/l in comparison with all standards of drinking water. The level of nitrite of the samples were low and this may be attributed to existence of nitrogen in more oxidized (Nitrate; NO3) form.

viii.   Calcium

In the sulphate form ($CaSO_4.2H_2O$) is relatively less soluble in water. In calcium chloride and calcium nitrate form, the minerals are very readily soluble in water. However high concentrations of calcium in water tend to precipitate soap and are objectionable in laundry and other domestic or industrial purposes. Low calcium intake can be related to hypertension and cardiovascular disorders. The concentrations in the samples are 9.63, 15.24, 2.0, 10.43, 28.48, 8.42, 28.88 and 26.07mg/l which meet the Nigerian Industrial Standard and WHO for Drinking Water Quality permissible limit of 150mg/l.

ix.   Electrical Conductivity

This is used to estimate the total amount of dissolved salts in water measured in µS/m at the water temperature the range of conductivity 122, 163, 13, 160, 268, 125, 529, 1113 µS/m for samples A, B, C, D, E, F, G and H respectively. This underscores the presence of minerals and rock fragments bearing soluble minerals.

x.   Ammonia

The presence of ammonia indicates the possibility of sewage pollution and consequent presence of pathogenic microorganisms. Sample B, C and F had no presence of ammonia; sample A, D, E, G and H had 0.12, 0.73, 0.12, 0.24 and 0.24 respectively.

xi.   Bacterial Examination

The presence of bacteria and total coliform in the borehole water indicate contamination by human and animal wastes. These pathogens may pose a special health risk for infants, young children and people with severely compromised immune systems. The World Health Organization (WHO) had recommended zero value for bacteria and total coliform count in drinking water while NIS recommended zero for E.coli and 10 for total coliform. The level of Escherichia Coliform (E. coli) of samples A, B, C D, E, F G and H were 6, 0.0 13, 0, 0, 0, 30 and 52 cfu/100ml respectively. The values of sample G and H are extremely high, especially in groundwater which is being used for dinking purposes. The results indicated the pollution of the borehole water through faecal matters. For total coliform, only samples D and F were below the required standard set by WHO and NIS which is 10 cfu/mL.

xii.   Hardness

Hardness of water enhances water palatability. Sample C had 10mg/l total hardness and it was referred to as soft water, sample A, B, D, E, F and G of 53.1, 50, 51.1, 109.1 35 and 156.1mg/l total hardness was referred to as moderately soft water, while sample H was hard due to its 501.5 mg/l total hardness value. Hardness in water is that characteristic which prevents the formation of sufficient leather or foam, when such hard water is mixed with soap. It is usually caused by the presence of Calcium and Magnesium salt in the water, which form scum by reaction with soap. Hard waters are undesirable because they may lead to greater soap consumption, scaling of boilers, causing corrosion and incrustation of pipes, making food tasteless, etc

4.2.3 Water pollution in Lapai LGA

Water pollution of groundwater, from the pollutants released to the ground which work their way into groundwater, create a contaminant plume within an aquifer. Movement of water and dispersion whim the aquifer spreads the pollutant over a wider area, its advancing boundary often called plume edge, which can then intersect with groundwater wells or daylight into surface water such as seeps and springs, making the water supplies unsafe for humans and livestock.

Water contaminants are natural or anthropogenic (manmade). The manmade contaminants are the major causes of groundwater pollution in Lapai LGA from the research carried out on the samples shows the most communities in Lapai LGA suffer from chronic shortages of fresh water or the readily available accessible water resources are heavily polluted. Accelerated population growth coupled with impoverished socio-economic development with limited water resources and poor sanitation, leads to an increase in diseases associated with poor living conditions among which water-related and water water-borne play a major role. They get their drinking water supply from the groundwater sources. People from these communities often complain that the water tastes brackish which is normally an indication of poor quality. From this research, it was observed that the contaminants are mainly NO_3 and faecal pallet (Coliform and E-coli)

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