IMPACT OF HUMAN ACTIVITIES ON THE QUALITY OF WATER IN JABI DAM ABUJA

BY

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PGD/AGRIC/ENG/2000/2001/154

IN PARTIAL FULFILMENT OF THE CONDITIONS FOR THE AWARD OF PDG IN THE DEPARTMENT OF AGRICULTURAL ENGINEERING OF FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA.

JUNE, 2002

DEDICATION

I dedicate this project to my beloved son Oluwabori Olanrewaju Akinola Adigun who I lost in the cause of this project, precisely on the 14th of May, 2002. May his soul rest in perfect peace.

CERTIFICATION

This project titled: Impact of human activities on the quality of water in Jabi dam was carried out by Adigun Moses Olukunmi PGD/AGRIC. ENG/2000/2001/154. The project was certified by:

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ACKNOWLEDGMENT

I give glory to God almighty who made it possible for me to carry out this project. I acknowledge the fact that except He builds a house, the labourers are only labouring in vain. I thank Him for the possibility.

I appreciate the efforts of my project supervisor Dr. E. S. A. Ajisegiri who took the pains to take me through the rudiments of the project. Engr. Bashir Muhammed is one person I am indebted to so greatly for his concern, efforts and advise towards the success of this work. To Engr. Tope Alabadan I say thank you. I also thank the Head of Agric Engineering Department Dr. D. Adgidzi and all the members of staff of the department for their contributions.

I appreciate the co-operation and efforts of my wife Mrs. Folake Adigun and my children Ezekiel and Damilola Adigun during the course of this programme. You are wonderful people. God bless you. To all friends too numerous to mention but who contributed in one way or the other towards the success of this work. You shall be richly rewarded in Jesus name (Amen).

ABSTRACT

This work examines the impact of human activities on the quality of water in Jabi dam with the intention of finding solution to the problem and recommend ways of bringing Jabi dam back to life and serve as a suppliment to lower Usuma dam in supplying good quality water to Abuja metropolis. It was found in the analysis of the water samples taken that the coliform count of the dam is high as the E-coli was found to be between 32 and 108 mg/l while the faecial colliform was in some sample as high as 14. These are very high when compared with W.H.O standard which recommends 0 per sample. This it was discovered was as a result of the unrestricted access to the dam, which if controlled, will reduce drastically the colliform count problem. Depite the above the water in the dam is still found to be suitable for supply to the public in Abuja if given an adequate treatment because the minerals and salts content of the water in the dam are found to be adequate according to W. H. O. recommended standard.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 GENERAL

Water is life. The rate of water demanded all over the world due to the various uses to which there are no alternatives or replacements, explains the essentiality of the availability.

The importance of water can not be over-emphasised quality water both for public and agricultural use. These uses includes consumption, construction irrigation etc. Man requires water for his numerous activities be it domestic, agricultural or industrial. For water to be safe and reliable for these activities, it must satisfy the standard qualitative requirements recommended by responsible standard organizations such as world Health organisation (WHO) (1970 and 1971). These requirements are broadly classified on the basis of three different categories. These are:- Physical, Chemical and Bacteriological parameters.

Liquid and solid waste must be dvispelled off from the water in a very satisfactory manner in order to render the water pleasant and healthy for man's use.

Water quality and supply deals with the supply of quality water for man's use. The supply of water in its purest form for public helps in prevents and storage spread of diseases. Due to the location of the source of water and the activities that is being carried out within the environment e.g farming, washing etc. the quality of water is greatly affected because the products of these activities drams into the water.

The concept of water as natural resources is essential as growing population with corresponding food demand continual increament in the supplies of water. Due to this importance, different ways of water storage for domestic, agricultural and industrial use has been devised. These are reservoirs in form of dams, surface tanks, underground tanks and elevated reservours, not only to enhance its availability but also to effect its preservations.

1.2 WHAT IS WATER

Pure water is made up of two atoms of hydrogen (H_2) 'attached' to are atom of oxygen (O), knows as one molecule of water (H_2O). To the chemist, water is a chemical - tasteless, clear, odourless and colourless liquid substance. The normal drinking water contains several minerals and salts, such as iron (fe) manganese (Mn), calcium (Ca) magnersium (Mg) sulphate (So4) and fluoride (F) As well as gases such as carbon dioxide (Co_2), Oxygen (0_2) and nitrogen (N). Many of these minerals are lacking in the everyday human diet but yet, they are essential for health and the proper growth of the body. Water provides these elements but their proportions have to be carefully watched.

Thus, the drinking water is quite a chemist's mixture and this is what makes it pleasant to drink and not 'flat' as would be pure water. Lager measure of water such as the oceans and big lakes, give up invisible gaseous moisture (vapour) to the atmosphere; Visible moisture, such as steam, fog, cloud or falling rain, is not a vapour but very small drops of water that reflects the light such that we can see them.

1.2.1 SOURCES OF WATER

Clouds are formed by warm air containing water vapour, rising up, becoming cooled and reaching a dew-point where the vapour condenses into visible moisture. By further rising and cooling, the moisture air becomes 'saturated' which means that it can not hold any mere moisture. Condensation takes place and precipitation in the form of rain follows. This is one of the sources of life-giving water.

1.2.2 QUALITY IN RELATION TO SOURCE

The quality of natural Water itself is an associated liquid consisting of hydrol H_20, dihydrol $(H_20)_2$, trihyorol $(H_20)_3$ and hydrogen and hydroxyl ions H^+ and OH^-. The impurities in water occur in three progressively finer states of subdivision; suspended, coloids and dissolved which are of significance in that they influence the methods required for the removal of the impurities. The total amount of solid impurities in water is obtained by the total solids test, in which a sample of unfiltered water is evaporated and the residue weighed.

The result is expressed in parts per million (ppm) by weight and it includes the suspended, colloidal and dissolved solids.

A suspension is a dispersion of solids particles that are large enough to be removed by filtration in settling. Such particles are macroscopic and contribute turbidity to the water. The concentration of suspended matter in water is measured by its turbidity or by the suspended - solids analysis. The turbidity of a water is its capacity of absorbing or scattering light and is measured by the concentration of fine silica in ppm which produces an equivalent effect. The suspended solids content of a water is the concentration in ppm by weight of solid matter removed from the water by filtration through a filter paper. There is no definite relation between suspended solids and turbidity in as much as the size and character of suspended particles as well as their concentration influence the later by weight. The ratio of the suspended solids to the turbidity called the co-efficient of fineness is a measure of the size of particles causing turbidity, the particles size increasing with the co-efficient of fineness.

The suspended solids determination is widely used for concentrated suspensions such as sewage but is difficult to apply to relatively clear water and therefore is not commonly used in routine water analysis.

A colloid, or solution is a finely divided dispersion of one material called the dispersed phase in another called the dispersion medium. An aqueous suspension colloid is a water solution of solid particles that are too small to be removed effectively by ordinary filters and which are so small that they exhibit Brownian motion (i.e. they diffuse) and that the electric charges on their surfaces are large enough in comparison with their mass. The dectric charges is due to the presence of adsorbed ions on the surface of the solids and the material of the particle and pH value of the liquid determines the sign of the charge. Neutral or acidic materials such as silica glass and most organic particles tend to acquire negative charges in neutral water, whereas basic material such as the metallic oxide $Al_2 0_3$ and $Fe_2 O_3$ tend to be possitively charged.

Many colloidal particles also absorb water and when the amount of absorbed water is large as compared with the solid matter in the particles the colloid is called an emulsion. Most of the properties of colloidal particles are due to their size.

Colloidal particles can not be seen with the naked eye except with the aid of a Tyndall cone of light. In ordinary light, a suspension appears clear but is usually coloured.

Most of the colour of water is due to the presence of colloidal particles but some colloidal matter such as silica are colourless. There is no convinent means in routine laboratory technique for measuring the amount of colloidal matter in water, but the colour tests is an indication of the concentration of certain types of colloidal matter.

The colour of water is the amount of platinum in platinum-cobalt colour standard expressed in ppm required to match the strength of colour of the water. In order to remove colloidal particles from water, the colloids must first be concentrated into large particles by coagulation, after which settling and filtration methods of removal became effective. Some colour may also be removed by adsorbent.

A solution is a molecular or ionic dispersion. Solids, liquids and gases are disolved in natural water. Some substances, particularly organic compounds, remain in solution largely as molecular dispersions. Other substances, the strong electrolyes, ionize completely when they are dissolved in natural water.

Practically, all inorganic rocks or salts found in true solution in natural are fully ionized in the concentrations in which they normally occur. The concentration of total dissolved solids, usually expresses in ppm is obtained by weight, the residue after evaporation of the water from a filtered sample. The determination will include colloidal matter if present, sustained in true solution may be removed from water in a variety of ways. Some dissolved solids may be removed by adding a chemical that reacts with the soluble substance to form a precipitate, the precipitate being subsequently regulated and removed by sedimentation and filtration. Some dissolved substances many be removed by an exhaust processes with zeolites and some by adsorption on activated carbon or other adsorbents. Still another method is aeration for the liberation of gases, volatile and odoriferous substances and for the precipitation of ions.

Most of the substances that occur in natural water are shown in table 1. 1 All these substance may not occur in any single water and their concentration varies widely for different waters. Some substances of sanitary significance occuring in water because of artificial contamination such as phenols and cyanides, are not specifically included in the table. Other substances such as the secretions of certain micro-organism which cause odours but which in such minute amounts that they can not be detected by chemical analysis, are not shown.

The presence and concentration is indicated by odour measurements. Several other substances of some sanitary significance such as lead, copper, zinc and chlorine cl_2, which enter water because of treatments as from the pipes of the distribution systems, are not shown since they do not usually occur in natural waters.

TABLE 1.1 SUBSTANCES OCCURRING IN NATURAL WATERS

SUBSTANCE	SUSPENDED	COLLOIDAL	DISSOLVED		
			POSITIVE IONS	NOT IONISED	NEGATIVE IONS
of mineral origin	Clay, sand Other Inorganic soils	Clay silica S_1O_2 Iron oxide Fe_2o_3 Alumina Al_2O_3 Manganese Oxide Mno_2	Calcium Ca^{2+} (40) Magnesium Mg^{2+} (24.3) Sodium Na^+ (23) Potassium K^+ (39.1), Iron Fe^{2+} (55.8) Manganese Mn^{++} (54.9) Hydrogen H^+ (1)		Bicarbonate Hco_3 (61) Sulphate so_4, (96) Chloride cl^- (35.5) Nitrate No_3 (62) Carbonate Co_3^- (60) Hydroxyl OH^- (17) Silicate $HsiO_4$ (77.1) $H_2Bo_3^-$ (60.8) Phosphate HpO_4^{2} (97) Iodide I^- (126.9) Fluoride F^- (19)
of organic origin	Organic soil (top soil) Decomposing organic wastes	Vegetable colouring Matter organic wastes	Ammonium NH_4^+ Hydrogen H^+	Vegetable Colouring Matter Organic Wave Ammonia, NH_4OH, carbonic acid H_2Co_3 other organic acids.	Nitrate No_3^- Nitrite No_2^- Hydroxyl (OH^-) Bicarbonate Hco_3^- Other organic acids.
Gases				Free carbon dioxide Co_2 oxygen O_2 Nitriate N_2 Hydrogen, H_2 Sulphid H_2S Methane CH_4 Sulphurdioxide So_2 Ammonia NH_3 Odorivectors	

1.3 JABI DAM

1.3.1 LOCATION

Jabi dam is located at about the centre of Abuja territory. It is found along the express way that links life-camp with the city centre through mabushi and the Federal Ministry of Works and Housing. It is named after Jabi, a settlement in Abuja minicipal area council and which hasts the dam.

1.3.2 WATER COURSE AND PROFILE

Jabi dam is constructed on an flowing river that comes from Bwari area, through Gwarinpa, Katanpe, Jabi, Mbora down to Kuje-Gwagwalada axis. The river always flows both during rain and dry seasons making the volume of water in the dam always very stable. The dam covers about 300metres stretch and averagely 70 meters wide.

1.3.3 POTENTIAL CAPACITY

Jabi dam was designed originally to cater for the water needs of the resident of the city centre of a population estimate of between 700,000 and 1 million people, and for the on going construction works and the planned expension. The dam the expected to produce about 7.5×10^9 liters of water daily. This was expected to meet the demand enumerated above and other sundaries that may arise.

JABI DAM LAYOUT
THE RETAINING WALL
CITY CAPITOL HOTEL
CAR WASH
X POINT C
X Point D
X Point A
X Point B
EXPRESS ROAD BRIDGE

1.4 STATEMENT OF PROBLEM

Jabi dam was constructed originally to meet the water demand for consumption and constructions in Abuja metropolis as stated in section 1.3.3 earlier. As time goes on however, the ever increasing population of Abuja outgrows the water supply from Jabi dam and it became apparent that in not too long a period, if another alternative was not sought quickly there would be acute shortage of water supply in Abuja. This was how the idea of lower Usuma dam was born.

Jabi dam was still to serve as a compliments to lower Usuma dam but human activities around the dam rose so astronomically and became very uncontrollable with the emergence of Hotels, recreatianal centres, block industries, residential estates etc right at the bank of the dam. All these features contribute things ranging from wastes, faces and industrial emissions into the dam. Thus it renders the quality of water thereof very uncertain. This finally led the government to decide to drop the idea of using the dam for potable water supply to the metropolis.

1.5 OBJECTIVES OF THE PROJECT

This project work is to study the impact of human activities on the quality of the waters in Jabi dam. The study should be able among others:

i. To find the effects of different features of human activities along the Jabi dam on the quality of water there in.

ii. To evaluate the quality of water at present in the dam.

iii. To make recommendations to the authority on the possibility or otherwise of resuscitating the dam.

1.6 JUSTIFICATION

Since Abuja, the Federal Capital Territory of Nigeria is ever increasing in population and water is one major demand of every human being, animal, plants and even construction projects, there is a probability that, no matter what provision is made today for the adequate supply of water, a time will come when this provision will fall short of the demand. This is why every available opportunity to get water has to be fully explored and thus Jabi dam upon which government has spent a lot of money should not be allowed to be a total waste, it has to be resuscitated.

To achieve this, its quality has to be examined for various uses such as:

i. To protect the health of the consumers by eliminating water-borne in sections.

ii. To make the water suitable for construction according to B.S standards.

iii. To protect plants against dissolved chemical that will affect their growth.

iv. Also the removal of impurities which though not being harmful are automatically impleasant e.g. taste, colour, odour and turbidity.

v. For economic reasons, for example in softening water and removal of iron to reduce laundry costs and save the laundry materials.

vi. For other miscellaneous reasons e.g. to reduce corrosiveness in pipes and to add desirable elements e.g. iodine and fluorine.

1.7 SCOPE OF STUDY

The scope of this project is to

i. Identify the sources of human activities along Jabi dam

ii. Assess the impact of each of the feature of human activities on the dam.

iii. Analyse the quality of water in the dam and determine the suitability or otherwise of the water for human usage.

iv. Make appropriate recommendations to the authority concerning the future use of the dam.

v. Compare the present quality with the previous water quality and access human factor on quality.

vi. Record the level of treatment of present water in the dam.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 CLASSIFICATION OF RAW-WATERS

Raw waters are classified according to the treatment required on each type of water before it becomes potable. Some of the groups are as follows:

Group I: Water requiring no treatment: Limited to underground waters not subject to any possibility of contamination and meeting the standards of drinking water everywhere.

Group II: Waters requiring simple chlorination: This includes underground and low centamination surface waters containing 50 coliform bacteria per 100ml per month.

Group III: Waters requiring complete rapid-sand filtration and continous chlorination. This group includes water requiring removal; waters requiring high amounts of chlorination, waters polluted by sewage to such an extent that they contain an average coliform count of 50 - 5,000 per 100ml per month and beyond this number is not more than 20% of the samples examined in any one month.

For group III, Anxiliary treatment includes pre-sedimentation with coagulation, pre-chlorination, or more storage for extensive periods (30 or more days) Ref: Developing World Water Grosvenor Press Int.

2.2 WATER SUPPLY

2.2.1 CLASSIFICATION

Water supplies are classified as surface and ground-water. Surface supplies may be divided into two groups:

a. Those from large rivers or lakes which must be pumped into the distribution system and

b. Those from smaller upland streams which require storage reservoirs and aquaducts or pipe lines for delivery usually by gravity to the distribution systems.

Ground-water supplies are obtained from wells, springs and filter galleries.

2.2.2 SOURCES OF SUPPLY

An important consideration in the selection of sources of water supply is its reliability. A supply should be capable of furnishing an adequate quantity of water continuously with a minimum damage or interruption due to breakdown or other causes.

The relative order of reliability (A gravity source of supply that is inadequate at times and therefore require storage reservours) from the stand point of quantity of water is substantially as follows:

i. A surface or ground-water supply from a practically in exhaustible source distributed to and throughout the city by gravity.

ii. A gravity source of supply that is inadequate at times and therefore requires storage reservoirs.

iii. A never - failing source that requires pumping.

iv. A source of suppling that requires both storage reservoirs and pumping.

2.2.3 EFFECTS OF SOURCE ON WATER SUPPLY

The quality of water is determined by its contents of living organisms, mineral and organic matter. Living organisms may be present in suspension and in colloidal dispersion, mineral and organic matter may be in solution in colloidal dispersion and suspension. Practically, all the foreign matter in water is collected as the water over the surface of the ground or through the soil and rocks. Rain water is saturated with the gasses of the atmosphere, but it contains a few other impurities except in areas where the atmosphere is charged with smoke, industrial fumes or dust.

2.3. PURIFICATION OF WATER

Water treatment involves physical, chemical and biological changes, which transform raw waters into potable water. The treatment to be employed has to be worked out from both the knowledge of the quality of the raw water and the purpose for which the water is needed.

TREATMENT TO CONVERT RAW RIVER WATER TO POTABLE DRINKING WATER

In addition to minerals and gases, water can also contain harmful bacteria. These are usually the result of contamination along river by sewage. They create what is known as excremental diseases and are harmful to man, common diseases of bacterial origin are:

1. Dysentery
2. Gastroenteritis
3. Typhoid
4. Chotera

Water can also contain viruses that can lead to infectious hepatitis, poliomyelitis etc. Viruses are very minute compared with bacteria and will therefore pass through filters more readily.

Other diseases are caused by animal worms or flukes, the most common being bilharzia. Irritant substances such as sand and mica, can cause gastro-intestinal disorders. All those organisms which cause ill-health are often refered to collectively as 'pathogens'. It is desirable to make every effort to remove as much of these harmful impurities from water as possible. The population must be reduced to acceptable level for safely. The following methods of attacks have been considered.

i. **Protection at source**

   This is of the utmost importance and draw-off should be taken as far unstream as possible. It will reduce the risk of contamination by both animals and humans.

ii. **Storage and sedimentation**

   This is really the first stage of treatment since pathogenic bacteria will not normally survive in water for more than 30 days. Some organisms will die off 48hours and so even a limited period of storage will remove some pathogens. Storage also acts as a reserve and allows dilution of undesirable substances. Much solid matter will also settle to the bottom (sedimentation). If the water is stored for a day or more, thus improving the physical quality of the water.

iii. **Filtration**

A good degree of bacterial purification is obtained by utilising sand filters at a flow rate of less than 22, 500 M^3 per ha per day.

iv. **Chemical disinfection**

This is the most powerful weapon we have against becteria. It can be applied as a final process to correct any re-pollution of treated water. The most common chemical used is chlorine, either in gas, solution or powdered form. In practice, it has been found that other chemicals can be added to advantage.

a. Aluminium sulphate $Al_2 (SO_4)_3^0$ $18H_20$. Often confused with alumina (which is just an oxide of aluminium), this chemical creates coagulation. When added to water, it reacts with the natural or created alkanity to form colloidal aluminium hydroxide. This then floculates into large particles like flakes, in which suspended matter and colour are trapped or absorbed. This coagulation results in less unwanted impurities passing between the grains of sand in the filter. Aluminium sulphate is often added to water in the forms of an alum which is double sulphate salt.

b. Sodium carbonate Na_2 CO_3. Commonly known as soda ash. This is used to raise the PH or acidity level of the water to neutral after chlorine treatment.

The expression 'PH' is a convinent method of indicating the degree of acidity or alkalinity of a solution. The scale sums from O (extremely acidic through 7 (neutral) to 14 (extremely alkaline). If treated water remains too acidic, it becomes corrosive and will affect the steel pipe-works. It is convenient to make up solution of chemicals in water to reduce possible injury to the skin or eyes.

For rural water supplies, gravity solution dose can be used to apply the chemical in accurately measured amounts and they require no external power to operate them.

To sum up therefore, treatment can consist of the following functions:

i. Raw river water pumped up to storage / sedimentation tank of sufficient capacity.
ii. Aluminium sulphate dosing for coagulation
iii. Stored water pumped or gravity fed through a sand filter then to a second storage tank.
iv. Chlorine solution dosing to kill bacteria
v. Soda ash solution dosing to correct PH level
vi. Treated clean water piped to end user.

It may be that certain of the above functions will not be necessary, but only a close study of the raw water chemical and bacteriological analysis can determine this.

LIMITATION OF CHEMICAL USAGE IN DRINKING WATER

Some of the chemicals normally found in our drinking water have already been mentioned. There are however limits of the percentage content of these, beyond which our water can become umpleasant or even dangerous. Modern water workscarefully monitor these by regular analysis and take necessary actions to maintain acceptable levels.The following table is a guide to what these levels should be:

INDICATION	ACCEPTABLE LEVEL	EFFECT ABOVE LEVEL
Acidity	Above pH 7.0	Alkaline
Acidity	Below pH 7.0	Acidic
Aluminium	0.15ppm	Deposits
Ammonia	0.02ppm	Pollution
Calcium	200ppm	Hardness
Carbondioxide	10ppm	Corrosion
Chlorides	250ppm	Salt taste
Chlorine	0.2ppm	Taste
Colour	20 Hazen inits	Visual
Detergent	1ppm	Pollution
Fluoride	1ppm	Mottled teeth
Iron	0.2ppm	Taste
Lead	0.1ppm	Poison
Magnesium	1.25ppm	Hardness
Manganese	0.2ppm	Deposits
Nitrites	0ppm	Pollution
Nitrates	10ppm	Toxic
Oxygen	1.0ppm	Pollution
Phenol	0	Taste
Phosphates	1.0ppm	Pollution
Silica	20ppm	Scale
Sulpuite	250ppm	Taste, diarshoea
Total disolved solida(tds)	500ppm	-
Turbidity (tss)	5 Hazen units	Visual
Zinc	15ppm	-

Ref: Dennis B. Willcock Water Engineering

2.4 WATER QUALITY PARAMETERS

2.4.1 ALKALINITY AND HARDNESS

Alkalinity of water represents its content of OH^- or of other ions that combine with H^+ upon the addition of acid. The most important of these other ions is HCO_3, which is usually present in considerable quantity.

In alkaline waters, normal carbonate, Co_3^{--}, is a source of alkalinity since it forms $(HCO_3)^{2-}$ upon the addition of acid. Borate, (BO_4^-) silicates, (Sio_2^-) and phosphates (PO_4^-) also cause alkalinity, but they are usually not present in natural waters in appreciable quantities. Alkalinity is measured by titration with acid.

The amount of acid required to bring water to PH_4 expressed in (ppm) parts per million of equivalent $CaCo_3$ is called thotal, or methyl orange alkalinity. If the water is alkaline, the amount of acid required to bring the PH down to 8 expressed in (ppm) parts per million of equivalent $CaCo_3$ is called phenolphthalein which are indicator that have significant colour changes at about PH_4 and PH_8 respectively.

HARDNESS

The hardness of water represents its content of metals which form precipitates under the normal condition of use of the water. These includes all the metal in Table 1 except (Na^+) and (K^+) where salts are all soluble. Most of the hardness of water is due to the presence of Ca^{2+} and Mg^{2+} for these element occur in substantial amounts.

Hardness, like alkalinity, is expressed in ppm as $CaCo_3$. It is objectionable principally because of soap waste and boiler scale. The hardness, metals form insoluble precipitaties with soap and a leather cannot be obtained until all the hardness has been so precipitated. The precipitated hard soap moreover may form stains upon fabrice being laundered, particularly if Fe and Mn are present. Boiler scale is obtained by the precipitation of the metal as salts (principally carbonates, sulphates, chloride and nitrates) Owing to their increased concentration upon the evaporation of the water. If the hardness is less than 100ppm the water is generally considered soft, but for efficient boiler use and for certain industrial processing purposes waters of zero hardness are desirable.

In summary, hard water is water that has a high soap consuming power (i.e water which will not produce lather unless a large amount of soap is used).

Hardness in water is due primarily to the presence of Calcium (Ca) and Magnesium (Mg) ions in water. The presence of the following may also cause slight increase in hardness. Iron Fe, Manganese Mn, Copper (Cu), Barium (Ba), and Zinc (Zn), water is softened by two methods:

a. The line soda process in which Ca and Mg lons are precipitated and removed by sedimentation and filtration and

b. Ion exchange method, using zeolite, Ca and Mg cons are exchange for Na.

when water is softened with line it may be necessary sometimes to introduce Co_2 which results with any excess line to form Calcium CarbonateCa Co_3 which is precipitated before filtration.

2.4.2 SANITARY SIGNIFICANCE OF IMPURITIES

The impurities of greatest sanitary significance in water to be use for drinking purposes are the pathogenic bacteria and other pathogenic micro-organisms.

In addition to minerals and gases, water can also contain harmful bacteria. These are usually the result of contaminations along rivers by sewage. They create what is known as excremental diseases and are harmful to man. Common disease of bacterial origin are:

i. Dysentery

ii. Gastroenteritis

iii. Typhoid

iv. Cholera

Water can also contain viruses that can lead to infections hepatitis, poliomyelitis etc. Viruese are very minute compared with bacteria and will therefore pass through filters more readily. Other diseases are caused by animal warms or flukes, the most common being can bilharzia. Irritants substances, such as sand and mica can cause gastro-intestinal disorders. All these organisms which cause ill-health are often refered to collectively as 'pathogens.

It is desirable to make every effects to remove as much of these harmful impurities from water as possible.

2.4.3 REQUIRED CHEMICAL STANDARD FOR DRINKABLE WATER

Physical Characteristics

1. Turbidity shall not exceed 10ppm (silica scale)
2. Colour shall not exceed 20ppm (standard cobalt scale)
3. There should be no objectionable taste or odour.

Chemical Characteristics

1. Lead pb, shall not exceed 0-1ppm.
2. Fluoride f, shall not exceed 1.5ppm.
3. Assenic As, shall not exceed 0.05ppm.
4. Selenium SSc, shall not exceed 0.05ppm.
5. Hexavalent chromin Cr^{bt} shall not exceed o.05ppm.
6. Salt of Barium Ba hexavalent chromin Cr^{bt}, heavy metal, glucosides, or other substances with deletaries physiological effects shall not be added for water treatment purposes.
7. Copper Cu, should not exceed 3.0ppm.
8. Iron fe, and magenese Mn, together not exceed 0.3ppm.
9. Magnesium Mg, should not exceed 125ppm.
10. Zinc Zn, should not exceed 15ppm.
11. Chloride cl, should not exceed 250ppm.
12. Sulphate $S0_4$, should not exceed 250ppm.
13. Phonetic compounds should not exceed 0.001ppm in terms of phenol.
14. Total solid should not exceed 500ppm. But may be permitted up to 1000ppm.

15. For chemically treated waters the PH should not be greater than 10.6, the normal carbonate (Co_3^{2-}) alkalinity should not exceed 120ppm as Ca CO_3 and the total alkalinity should not exceed the hardness by more the 35ppm as $CaCo_3$.

Many of the requirements of the U.S.P.H.S. standards have not health significance although they are of aesthetic importance. The presence of too much lead pb may result in lead poisoning. Lead is not present in natural waters but may enter by solution from lead services and plumbing systems if the water is corrosive to lead. Asenie, (As) Selenium, (Se) and hexavalent Chrominium (Chr) are all toxic and their concentration must be limited.

The toxity of copper to man has been the subject of much discussion, but it now appears that Cu is not injurious up to concentration of about 20ppm. The taste of water become objectionable when Cu content reaches about 5ppm. Zinc appears to be safe in drinking water up to concentrations of about 40pmm, but with that concentration, it will impart a milky appearance and an astringent taste to the water. Too much Magnesium sulphate Mg SO_4 (Espson salt) and NO_2 So_1 (Glanber's salt) in water produce laxative effects. Sodium chrloride Nacl and Nodium Nitrate (N_aNO_3) tend to produce thirst, and carbonate and hydroxide(OH) tend to neutralise the acid of the stomach. Iron is non-official to the health, it is objectionable because of red water and streams. Manganese Mn is more objectionable than Iron fe because of streams and because of its interference with the orthotolidine test for residual chlorine. It's concentration should be limited to less than 0.1ppm.

The presence of fluoride in concentration exceeding 0.5ppm may result in wild endemic dental fluorories (mottled enamel) in children, although about 1.5 or more ppm of is require for severe cases. It has recently been found that fluoride in the drinking water is accompanied by new incidence of dental caries (tooth decay) in children and many health officials are now advocating the addition of fluorides to drinking water up to about 1.0ppm in region where carries is prevalent. Because simple epeites has been shown to be due to a deficiency of iodine in the thyroid gland, many attempts have been made to supply the deficiency regions where this condition is endemic by adding Na to water supplies. Studies of the relationship of the incidence of goiter to the I (Iodine) content of drinking waters have giving a conflicting results. It is probable that I (Iodine) in organic combination of foods where it is also more concentrated is more readily assimilated than I(iodine) in water.
Disaffection by means of ionic and colloidal silver is growing for swimming - pool waters but this method should not be used for drinking water until more is known about the effect upon, the human body of thus infested.

2.4.4 BACTERIOLOGICAL STANDARDS

Coliform organisms should ideally be absent from any water entering a system whether treated or untreated. Both the World Health

Organisation (WHO) and Environmental Protection Agency (E.P.A) recognised that the presence of coliforms become significant over a period of time. The most up-to-date standard, today is, EPA standard, which recognises the use of membranes filters. The WHO standards are quoted only for completeness as one expects to be updated in the not-too-distant future. This is the standard that has been adopted for the purpose of comparism for this studies.

2.4.5 <u>THE W.H.O (1971) RECOMMENDATION FOR THE WORLD ARE AS FOLLOWS:</u>

<u>Treated Waters:</u>

In 90% of the samples examined throughout the year the MPN index of coliform micro-organisms should be less than 10. None of the samples should show an MPN index areas than 20.

For Europe, WHO (1970) recommends that of the 100-ml samples taken throughout the year should not show the presence of any coliforms.

The U.S. standards deal separately with membrane filters and multiple - tube methods of coliforms assessment in water. For membranes filtration the maximum number of coliform should be:

a. One per 100ml as the Arithmetic means of all samples examined per month

b. Four per 100mls in more than one sample when less than 20 are examined per month or

c. Four per 100ml in more than 5% of the sample when 20 or more are sample are examined per month.

For the multiple-tube fermentation method, the sample may either be 10ml or 100ml. Details of the combinations are in standard methods. When 10ml samples are used, coliform bacteria should not be present in:

a. More than 10% of the portions in any month.

b. Three or more portions in more than one sample when less than 20% samples are examined per month.

c. Three or more portions in more than 5% of the sample when 20 or more samples are examined per month.

When 10ml samples are used coliforms bacteria should not be present in:

a. More than 60% of the portions in any month.

b. Five portions in more than one samples when less than five sample are examined per month.

It will become clear from the differences in the regularity of sampling between 10 ml and 100ml sample the more likely it is that coliforms will be picked up.

2.4.6 OTHER W.H.O AND EPA STANDARDS

The sampling regularity required for chemicals determination by the WHO and EPA vary from 3 months to 2 years. But it would be more frequent when waste discharges into the water are expected. Some of the chemicals for which analysis is done are toxic beyond a centain level. Other may affect the aesthetic and other aspects of the water without necessarily affecting health. The chemical for which analysis required or recommended are given in the following table which also indicates the level beyond which they become toxic or given rise to various difficulties, which are themselves listed:

2.4.7 CHEMICALS FOR WHICH ANALYSIS IS REQUIRED OR RECOMMENDED IN WATER (W.H.O. 1970, 1971)(EPATY 1976)

SUBSTANCE	CONSEQUENCE OF EXCESS AMOUNT IN-ORGANIC CHEMICALS		LIMIT ALLOWABLE IN WATER (MG/LITIES)	
		a	b	c
Arsenic	Toxic	0.05	0.2	0.05
Baruim	-	-	-	1.0
Cadmium	Toxic	0.01	-	0.01
Chromium	Toxic	0.05	0.5	0.05
Cyanide	Toxic	0.05	0.01	-
Fluoride	Fluorosis	0.7 - 1.7	1.0 - 1.5	1.4 - 2.4
Lead	Toxic	-	-	0.05
Mercury	Toxic	-	0.01	0.02
Selenium	Toxic	0.01	-	0.01
Sitter	Toxic	-	0.05	0.05
Nitrate	Danger of infertility Methare - oglobinaemic	50 - 100	-	10.00
Pherolies	Taste especially in Chlorinated water	0.001		
Copper	Astingent taste discolourate and corrosion of pipes.	0.5 - 3.0		
Iron	Taste discolouration deposits and growth of Iron	0.1		
Manganese	Bacteria Turbidity.	0.05		
Zine	-do-	5.0		
Magnesium	Astingent taste	30 - 250		
Sulydrate	Opalescence. and sand-like	350		
Hydrogen Sulphide	Deposites Hardness tastes Gastro-intestinal irritation. Taste and odour.	0.5		

ORGANIC CHEMICAL (PESTICIDES)

Enderni	Toxic -	-	0.002
Hindane	-do- -	-	0.004
Methoxychier	-do- -	-	0.1
Toxaphene	-do- -	-	0.005

TURBIDITY

The EPA regulations requires that drinking water be sampled for turbidity at least once a day by the Nephelometric method set out in standard methods. The method consists of comparing the turbidity along with that determined in a series of tubes containing suspended particles of formazin polymer. The maximum level of turbidity allowed is a monthly average of one turbidity unit (TU). Not more than five may be allowed if it can be shown that this level of turbidity does not interfere with disaffection or with the counting of micro-organisms.

RADIOACTIVITY

The level of radioactivity in drinking water is important in economically advanced countries. A number of economically developing countries have acquired or are arranging to acquire nuclear capability. The EPA standards which are quoted here should be the aim of the, latter category countries, since that body will appear to have a lead in the technical expertise of assessing these materials. The regularity of assessment is from one to two years, using method given in standards methods or indicated in the EPA publication (1976).

The maximum radioactivity in drinking water includes the following:

The maximum contaminant level for radium 226, and gross alpha particle radioactivity is given thus.

a. Combined radium 226 and radium 228 - 5pli/litre

b. Gross alpha particle activity - 15pli/litre.

The maximum contaminant levels for both particle and photein radioactivity from man made radio-nuclides in water should not produce on animal dose equivalent to the total body or any internal organ greater than 4 mitre per year.

W.H.O STANDARD FOR PHYSICAL AND BACTERIOLOGICAL PARAMETERS FOR DRINKING WATER

PARAMETERS	HIGHEST DISPERAISAL LEVEL (MG/L)	MAXIMUM PERMISSIBLE LEVEL (MG/L)
APPEARANCE	CLEAR AND ATTRACTIVE	CLEAR
TASTE AND ODOUR	UNOBTECTARLE	UNOBJECTABLE
COLOUR (^{0}H)	5	50
TURBIDITY	< 5	25

BACTERIOLOGICAL STANDARDS

The standard for the bacteriological characteristics is stated below:

1. Throughout any year 95% of samples should not contain any coliform organisms in 100ml.
2. No sample should contain e.coli in 100ml of sample analysed.
3. No sample should contain more than 10 coliform organisms per 50ml.
4. Coliform organisms should not be detectable in 100ml of any

consecutive sample.

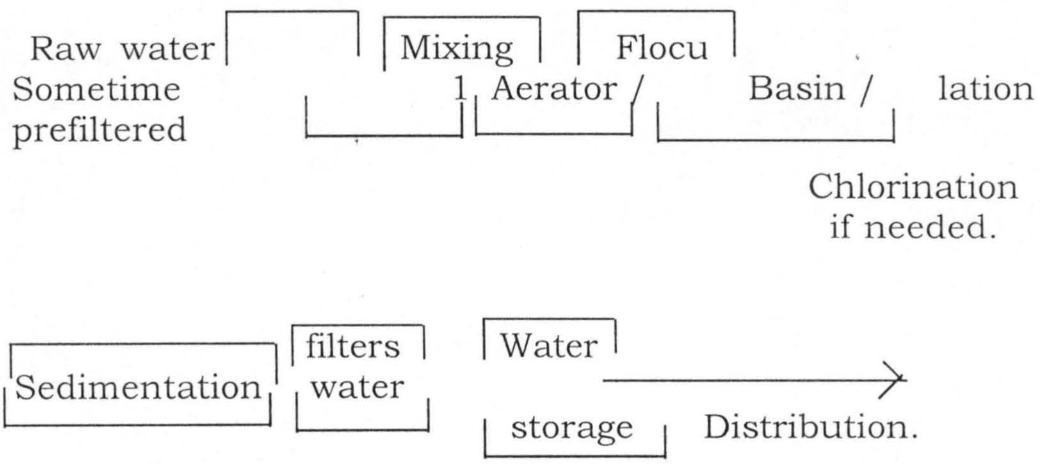
Source - W.H.O. Guidelines for drinking and agricultural water (1984).

2.5 TREATMENT OF DRINKING WATER

All or some of following treatment are given to raw water to make them suitable for drinking.

1. Pre-filtration.
2. Storage and sedimentation without coagulation.
3. Aeration.
4. Filtration.
   a. Slow - sound
   b. Rapid sound (with pre-coagulation and redimentation)
5. Chlorination
6. Iron and Manganese Removal.
7. Softening of water (sand stabilization) or demineralization.
8. Fluoridation
9. Algea Control (Sand taste and odour control).

A flow diagram of water treatment is given below:



Water Treatment Processes

The quality of water remains serious concern especially for human and livestock consumption hence the need for water treatment. The treatment of water improved it's sanitary condition.

2.6 ANALYSIS

The most important thing when taking samples of water for analysis is to ensure a freedom from outside contamination. This is done by washing the container thoroughly and finally rinsing well with the water to be sampled.

For a full chemical analysis, $2^1/_2$litre of the sample are required. These should be glass or plastic container clearly labelled and filled to the top. Analysis should be made with as little delay as possible so that the sample will remain unpolluted and the result will be genuine.

In addition to the above, a bacteriological analysis need to be carried out, which gives a deeper insight into the quality of the water we drink. The chemist will usually supply about 15 small bottles each containing a 'medium'. A prescribed number of millitetres of sample water are added to each bottle by means of sterilized syringes. The chemists will carry out a presumptive coliform count, which is an accurate pointer to the presence of excretal pollution. he will be looking through his microscope for various types of coliforms.

It the number of coliforms lies between 10 and 25 per 100ml of water, or if the number of coliform is greater than 1 or 2 (per 100ml), the water is considered unfit for drinking and further treatment is recauseded.

The following table is an example of a typical full chemical analysis of water.

CHATER THREE

3.0 METHODOLOGY

3.1 SITE VISIT

A visit to Jabi dam was made in April 2002. The visit affords one to have a first hand information about the dam. Getting to the edge of the dam was not much of a problem as many acess to the place were opened through various activities that is going on around there. By the east side, there was an entrance through the estate site of ABB and by the west side another entrance through a car wash garage. It was the attempt to get to the side of the earth dam wall that was utterly impossible as swamps around there was very thick and impassable. With the visit one was able to really assess the various human activities around the dam.

3.2 HUMAN ACTIVITIES ASSESSMENT

3.2.1 RESIDENTIAL ESTATES

Among the residential estate under construction along the edge of the dam is ABB (Asea Brown Bovery) residential estate; National Electric Power Authority (NEPA) housing estates and about two other estate owned by private developers. Apart from these, there are other houses some of which are already completed and occupied.

3.2.2 INDUSTRIES AND CAR WASH

To the east of the dam are found/ located about seven different block industries. To the west are many car wash garages. Both the block industries and the car wash takes water for their activities directly from the dam and waste from them are drained into the dam. These waste emmanates from wetting of the blocks, washing of cars and the workers after the days job, takes their bath in the dam.

3.2.3 RECREATIONAL CENTRES/HOTELS

There is this recreation garden made by Julius Berger for Mrs Mariam Babangida right at the edge of the dam by the west bank. Visitors to the garden throws all manner of things into the dam. Also there is this city capitol Hotel by the west bank of the dam. All the waste water from the hotel is emptied into the dam.

3.2.4 FARMING ACTIVITIES

Peasant farmers abounds all around the dam. Their main area of concentration for planting is food crops like maize cassava, vegetables etc. This means they always give intensive watering of the crops, and usage of ferterlizers is common. Water for the wetting of the crops comes from the dam and the drains from the water which carries part of the chemicals along, flows back into the dam. The farmers bathing is directly in the dam and washing of their products after harvest and before sale is also in the dam.

3.2.5 OTHER ACTIVITIES

Some local dry cleaners and individuals around Jabi bring their clothes, rugs and even dirty plates to the dam for washing. During the visit, many clothes were seen spread on the retaining wall of the dam. Those clothes were washed in the dam.

Fishermen are also having a field day on the dam. Causes line up I used beside the dam which the fishermen are using for their activities in the dam.

Some young men were seen swimming in the dam and information had it that they do that on a daily basis. Flower garders and nursery plants exist all around the place.

3.3 PERSONAL INTERVIEW

The area manager of lower Usuma Dam water works F.C.T water board under whose Jurisdiction Jabi dam is, Also one Mr. Adebayo of engineering department FCT water board headquarters was interviewed. Also interviewed are some of the people working around the dam, these include car washmen fishermen and workers in one of the block industrial around the dam.

The area manager and an employee of FCT water board revealed that the government decided to abandon Jabi dam and go for an alternative source of water supply to Abuja metropolis when the human activities around the dam became uncontrollable. The implication of this human activities is that the board has to spend much more than normal in the treatment of the water before it can become portable. The board at a stage discovered that the imput is much more than the return from the dam and since there is a much better alternative, a recommendation was made to the government by the board as to the abandonment of the dam. This the government found to be reasonable and therefore the action.

From the people working around the dam, it was discovered that the main reason for their presence in that environment is survival. The people that were interviewed confessed that they saw the easy acess to the water in the dam as an opportunity to make a living through their activities. It was also discovered that the Abuja environmental protection board also erroneously permitted sewer line to pass through the dam thus rendering the quality of the water in the dam very doubtful.

3.4 LOCATION OF SAMPLING POINT

Having gone round the dam and seen the activities going on around, it, was though wise to collect samples from different points as shown on the profile sketch point A is located beside a block industry; point B is behind a construction of residential estate ABB permanent housing estate; point C is after the car wash and city capital hotel while point D is at the centre of the dam.

3.5 EXAMINATION

3.5.1 COLLECTION OF SAMPLES

Samples of the water to be examined were collected in four clean stenrile $2^1/_2$ litters plastic container.

The four containers were labelled A to D and from different locations in the dam as described earlier. The samples for A to C were collected at about 2meters into the dam from the bank while at point D, the sample was collected at the centre of the dam and at the depth of about 10m.

The four bottles were taken to the laboratory at F.U.T. Minna immediately for analysis.

The whole process of taking sample has to be repeated twice making it two samples from each of the four different points, giving eight samples in all that was examined.

3.5.2 PHYSICAL PARAMETERS OF THE SAMPLE

This deals with the determination of colour, turbidity and odour and other physical factors capable of defecating the water such as total solid content. Physical properties can not be completely over looked in relation to chemical composition of the water. This parameters indicates acceptability or other wise of water to the consumer as they are widely used to establish its quality.

3.5.2.1 APPEARANCE

The appearance of water refers to the way the water looks. Appearance of can be affected by the level of impurities which the water contained e.g. Vegetable, Humus, Peat, Iron, Manganese and Industrial waste.

All the listed contaminants are capable of impacting colour to the water which will in turn makes it not attractive to consumers. The appearance of the water sample is determined by visual means. The sample was then assigned its appropriate terms either clear, or not clear.

3.5.2.2 TASTE AND ODOUR

Odour and taste depend on actual contact of the stimulating substance with the appropriate human recepter cell. The sense of odour is closely related to that of taste. In fact its normally correct to suggest that most tastes in water are really a sensation of smell.

There are four (4) sensation of taste: Sour, Sweet, Salty and Bitter taste. All other sensations are of odour, although not necessarily noticeable until the water is in the month. Some taste in water are however unrelated to odour and this include the blackishness associated with the relative amount of disolved salt (sodium chloride or magnesium sulphate). Odour and taste are recognised as quality factors which affects water in several ways. Determination of taste and odour is still based on subjective judgement given by a panel of tasters. It is also limited in application as a contaminated water sample may be too dangerous for taste testing.

3.5.2.3 P.H MEASUREMENT

This is the intensity of acidity or alkalinity of a sample measured by the *p.H.* which actually measures the concentration of hydrogen present. The *p.H* of water determines properly whether the water is fit for drinking or domestic use even in irrigating of crops. The *p.H* can be measured on a *pH* scale, which ranges from *pH* 1 to 14. *pH* 1 to *pH* 6.5 is considered acidic, *pH* 7 is referred to as neutral, and *pH* 9 to *pH* 14 is referred to as alkaline. The *pH* of water at 25^0C is 7.0. The *pH* of neutral water is usually governed by some hydrogen carbonate and carbonates in equilibrium.

P.H measurement in the laboratory, involves the use of two buffer solutions with PH 4.0 and that with PH 9.0; These two solutions are formed with the aid of two standard PH salts which are dissolved in water of particular quality. The PH meter is the equipment used in the measurement of degree of acidity or alkalinity of the various water samples collected. The PH meter has to be calibrated. To callibrate the PH meter, first the electrode which is connected to the PH meter through a wire cord is inserted into a container with PH 4.00. The electrode is then removed from the container of PH 4.00 and rinsed with distilled water and immediately put into the container with PH 9.00. After the figures have become stable at reading of PH 9.00 then the electrode is removed again and rinsed with distilled water and wiped with tissue paper or cloth, the electrode is then placed into the container with water sample whose PH is to be determined.

After the figures have stabilized on the dial, the PH of the water is read off, after which the electrode is rinsed again and then packed up.

3.5.3 CHEMICAL PARAMETERS OF THE SAMPLES

Chemical characteristics tend to be more specific in nature than some of the physical parameters and are thus more useful in assessing the quality of water. Physical parameters are easy to be determined and some may be readily observable by a lay man e.g

Temperature, Taste, and odour, colour, turbidity, solids and possibly the electrical conductivity. These physical parameters are not enough for the quality of water to be properly analysed. This is why the chemical analysis of water needs to be carried out and this is usually done in the laboratory. The chemical characteristics of water helps to know more about the water quality, especially the kind of dissolved element it contains. This will help to know whether the water is toxic or non toxic, the possible path of flow and what it has possibly come in contact with. This aspect of water analysis helps in knowing the level of pollution and contamination in the area.

TITRIMETRIC METHOD USED FOR DETERMINATION OF Cl^-, Ca^{2-}, Mg^{2+}

Determination of calcium and magnesium can accurately be carried out using titrimetric analysis which depends on the measurement of volumes of liquid reagent of known strength. The requirement of titrimetric analysis is as seen in pipette which is used to measure sample accurately. A standard solution of known concentration or strength, an indicator which is used to show the stoichiometric end-point. A graduated burette for accurate measurement of the volume of standard solutions necessary to reach end point. To simplify the titrimetric analysis, standard solutions of such concentration that they are equivalent to one another are usually employed. This involved the knowledge of equivalent weights of the reading solvents. Normal solutions are usually too strong for accuracy in titration and dilute solutions are used. It is often convenient to adjust the concentration to give a direct reading of the solvent determinant from the volume of titration. For the Initial standardisation of the solutions used in titrimetric analysis, a standard material of known purity is required. These primary standards are usually salts or acids salts of high purity, which can be accurately weighed.

Reagents required for the determination of Cl^-, Ca^{2+} and Mg^{2+}.

0.01M $AgNo_3$ solution

Potassium Dichromate

Distilled water procedure

25cm^3 of water sample were measured into a conical flask at 25°C, each.

5 drops of pottasium Dichromate indicator added to the samples in the conical flask. The samples in the conical flask were then titrated with 0.01m Ag No_3 to the end point.

Volume of 0.01m $AgNo_3$ used to the end point were all recorded.

CALORIMETRIC METHOD USED FOR DETERMINATION OF Fe^{2+}, Cu^{2+} AND So_4^{2-}.

The used of atomic absorption spectrophotometer to determine Fe^{2+}, Cu^{2+} and So_4^{2-} are very important in this practical analysis. It involves the use of electromagnetic radiation in invisible and ultraviolet regions of the spectrum to change electronic structures of atoms.

METHOD

Source emitting radiation characteristics of elements of interest (hollow cathode lamp with the element to be detected for as its filament). This is observed by passing radiation characteristics of particular element through atomic vapour of the sample. Sample vaporised by aspiration of solutions into a flame or evaporation are from electrically headed surface. The absorbency is proportional to the concentration of the element in the vapour and hence in the original sample and the reading taken each time. This procedure was carried out on all the water samples.

Reagent required for the determination of So^{2-}, Cu^{2+} and Fe^{2+}.

a. 0.02M H_2SO_4

b. Nacl and Hcl solutions

c. Na SO_4 solution (3g in $100cm^3$ H_2O)

d. Conditioning reagents

   i. $50cm^3$ Glycerol

   ii. $30cm^3$ concentrated Ba Cl_2

   iii. 75gm Nacl

e. Ba cl_2 crystals

a. Prepare serial standards or working standings from Na_2 So_4 stock solution.

b. Working standards should range from 5, 10, 15 and 20mg/ liter.

c. Add $10cm^3$ of the conditioning reagents, 1g of $Bacl_2$ crystals plus $2ml^2$ of 0.02m $H_2 So_4$.

d. Shake well and make up to the mark with distilled water.

e. Take the observance of the standards at 420mm against each concentration.

f. Pass the samples immediately after the addition of the reagents and when it has filled to the mark with the samples through the spectro-photometer.

g. Plot the graph of absorbency against the concentration of the standard.

h. Obtain the concentration of the sample by interpolation of the value obtained.

3.5.5 BACTERIOLOGICAL PARAMETER

While a chemical analysis is necessary for the purpose of detecting poisonous or corrosive substances in the water, for determining hardness and for giving indications for the degree of organic pollutant or pollution, chemical test can not show the presence or absence of pathogenic bacteria in water. Chemical and physical analysis should therefore be accompanied by bacteriological examination. This test is usually done to look for organisms, which are called coliforms, and most sensitive is Eschericha Coli, which is found in water. Their presence indicates contamination by faeces.

METHOD

The most probable number (MPN) test was adopted for the test, for the presence of E. coli in the water sample collected. This method is divided into three different stages, which are the presumptive test, the confirmed test and the completed test.

PRESUMPTIVE TEST

Serial dilution of decimal multiples and sub-multiples of 1 ml of water sample from all the samples was prepared in fermentation tube containing one inverted vial each are inoculated with lactose broth. The samples are incubated at 35^0c. After 24hours the samples were examined for gas formation, were shaking gently and they were closely observed for gas formation. Those sample without gas formation were shaking gently, they were closely observed for gas formation. The samples with formation of ions was indicate positive results while those without gass formation indicate negative results. The gram staining process follows.

The gram stain is the most important and frequently used in bacteriological analysis. It helps to differentiate bacteria into two groups, possibly showing major evolutionary relationships among those organisms. The two groups are gram positive (blue or purple, reactions to stain) and gram-negative (pink to red reactions to stain) the difference in reaction cell wall.

PROCEDURE FOR GRAM STAIN

A drop of sterile water was placed in the middle of a clean slide. A loop was sterilised by flaming and waved in the air to cool. A colony was touched using the inoculating loop, rubbed in the bacteria cells in the drop of water on the slide and spread into a thin smear along the slide.

It was allowed to air dried and then the rivers side was drawn quickly, three times over a flame in order to fix the bacteria, care was taken to avoid a prolonged exposure to flame. The slide was allowed to cool and smear is now ready to be stained. The inoculating loop was flamed before repeating the procedure above for other bacteria colonies.

GRAM STAINING PROCESS

a. The smear was flooded with crystal violet stain and allowed to act for 60secs.

b. The dye was drained quickly and washed with gram's iodine.

c. The iodine was left on for 60seconds.

d. It was drained and washed with water under the tap.

e. The slide was washed using 95% Ethanol until the slide appears free from violet stain. This process of differentiation takes about 15 seconds.

f. It was rinsed in tap water again.

g. The slide was then flooded with safranin for 30 seconds.

h. The stain was drained washed and blot dried.

OBSERVATIONS

The slide were examined under immersion objective lons, colours, shapes and sizes of the bacteria were noted.

CONFIRMED TEST

After initial bacteriological count, they were further in-noculated onto selective and differential medium, the plates were all examined for the presence or absence of E.colli therefore the result was recorded in a chart. Based on the results the portability of the water was determined. The presence of E.colli is a positive confirmed test and suggests that the water may be non-portable.

COMPLETED TEST

Gram staining of the cultured were made as already outlined earlier. The slides were examined mibroscopically for the presence of gram negative-short bacilli, which are indicative of e.colli and thus not non-portable. The results was obtained by counting the E.colli using start scientific colony counter. The result was recorded as to Gram-stain reaction and the number of e.colli found in each sample analysed.

CHATER FOUR

4.0 RESULT AND DISCUSION

4.1 LABORATORY RESULTS OR THE SAMPLES

Total number of the samples from 4 different points on the dam were taken for analysis (i.e 2 samples at each point). The two samples from each point were taken at one week interval. The results of the laboratory analysis is as produced below:

TABLE 4. WEEK 1 ANALYSIS

Physico-Chemical Examination Parameter	A1 bi	B2 abbhe	C1cw	D1 c
PH	7.2	6.9	6.8	7.2
Temparature OC	30.5	29.8	30	32
Colour NTU	11.2	1.8	2.1	7.9
Electrical Conductivity (umhos/cm)	21.9	3.4	1.4	15.9
Calcium (mg/l)	10	5.6	7.9	12
Sodium (mg/l)	3.4	6.7	6.7	10
Potassium (mg/l)	3	1.8	2.4	1.9
Sulphate (mg/l)	6.7	13.4	17	20
Chloride (mg/l)	41	3	18	20
Bicarbonate (mg/l)	8	11	13	6
Nitrate (mg/l)	7.8	2.2	0	3.9
Phosphate (mg/l)	1	0.1	1.1	2.2
Iron (mg/l)	0.11	0.1	0.12	0.21
Manganesium (mg/l)	0.39	0.48	0.49	0.52
Hardness (mg/l)	16.1	21.3	23	32.3
TDS (mg/l)	78	15	29	134
Dissolved Oxygen(mg/l)	3	2.1	0.9	3
Bacteriological Examination				
1. Faecal Coliform (CFU/ml)	12	7	5	9
3. E. Coli. (CFU/ml)	104	32	108	75
4. Total Plate Count (CFU/ml)	108	130	122	86

WEEK 2 ANALYSIS

Physico-Chemical Examination Parameter	A2 bi	B2 abbhe	C2cw	D2 c
PH	7.4	6.6	7.1	7.2
Temparature OC	31	27.8	31.2	3
Colour NTU	7.9	2.7	3.5	12
Electrical Conductivity (umhos/cm)	20	4	2.5	18.5
Calcium (mg/l)	11	6	9.7	10.8
Sodium (mg/l)	3.4	6.2	7.6	5.6
Potassium (mg/l)	1.76	1.7	2	1.8
Sulphate (mg/l)	8	16	18.5	32
Chloride (mg/l)	47	5	21	22
Bicarbonate (mg/l)	3	7	12	24
Nitrate (mg/l)	12	3.7	0.8	3.9
Phosphate (mg/l)	2	0.8	2.6	1.9
Iron (mg/l)	0.12	0	0.11	0.1
Manganesium (mg/l)	0.67	0.34	0.78	0.64
Hardness (mg/l)	17.8	21	22.3	34.9
TDS (mg/l)	62	23	18	120
Dissolved Oxygen(mg/l)	1	2	1.4	4
Bacteriological Examination				
1. Faecal Coliform (CFU/ml)	14	0	1	2
3. E. Coli. (CFU/ml)	55	34	58	45
4. Total Plate Count (CFU/ml)	87	78	67	32

A, B, C, D represents the four samples points

Abi - behind block industry

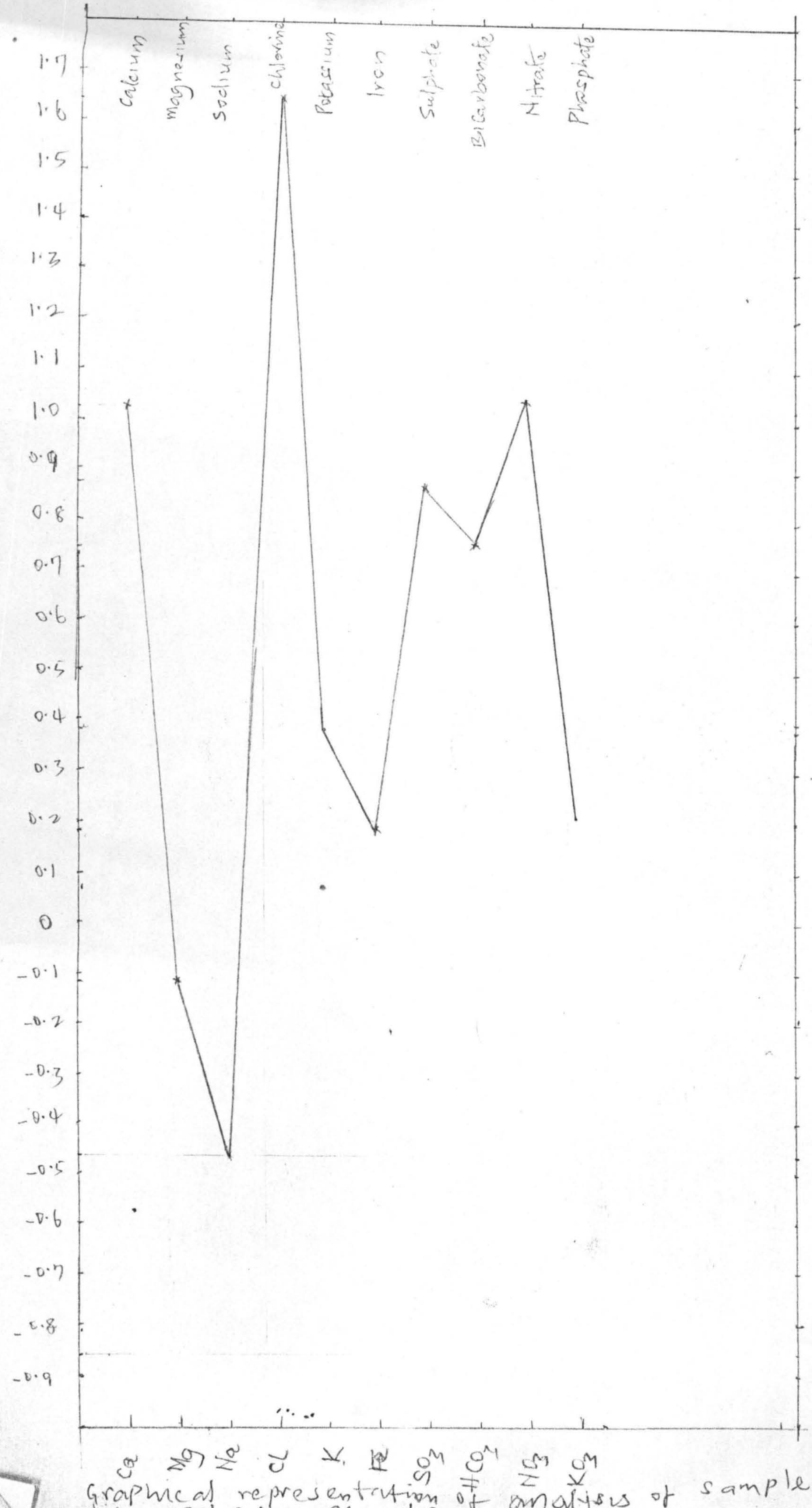
Babbue - Asea Brown Boveri housing estate

Chew - Behind Hotel and car wash

Dc - At the centre of the dam.

Maching the two results together for the sake of easy comparism, observation recommendations and of conclusions, we have the following:

Ref: Ground water Technology
T.C. Todd



Graphical representation of analysis of sample A using Schoeller semi log. diagram

	Ph	Colour NTU	Elect. Cond	Calcium C^{a+}	Sodium Na^+	Potassium K^+	Sulphate So_4^-	Chloride Cl^-	Bicarbonate HCO_3	Nitrate No_3^-	Phosphate Po_3^-	Iron Fe^{++}	Magnesium Mg^+	Hardness	TDS	Dissolved Oxygen	Gaecial Coliform	E.coli	Total Plate count
A1	72	11.2	21.9	10	34	3	6.7	41	8	7.8	1	0.11	0.39	16.1	78	3	12	104	108
A2	7.4	7.9	20	11	34	1.76	8	47	3	12	2	0.12	0.67	17.8	62	1	14	55	87
B1	6.9	1.8	34	5.6	6.7	1.8	13.4	3	11	22	0.1	0.01	0.48	21.3	1.5	2.1	7	32	130
B2	6.6	2.7	4	6	6.2	1.7	16 ·	5	7	3.7	0.8	0	0.34	21	23	2	0	34	78
C1	· 6.8	2.1	1.4	7.9	6.7	24	17	18	13	0	1.1	0.12	0.49	23	29	0.9	5	108	122
C2	7.1	3.5	25	9.7	7.6	2	18.5	21	12	0.8	26	0.11	0.78	22.3	18	1.4	1	58	67
D1	72	7.9	15.9	12	10	1.9	20	20	6	3.9	22	0.21	0.52	32.3	134	3	9	75	86
D2	72	12	18.5	10.8	5.6	1.8	32	22	24	3.9	1.9	0.1	0.64	34.9	120	4	2	45	32

The two tables below shows the World Health Oranisation recommended acceptable inorganic constituents for drinking water quality (WHO 1993) and acceptable levels of chemicals in drinking water.

CHARACTERISTIC	HEALTH BASED GUIDLINE
Antimony (mg/I)	0.005
Arsenic (mg/I)	0.01
Barium (mg/I)	0.7
Boron (mg/I)	0.3
Cadmium (mg/I)	0.003
Chromlum (mg/I)	0.05
Copper (mg/I)	2
Cyanide (mg/I)	0.07
Fluoride (mg/I)	1.6
Lead (mg/I)	0.01
Manganese (mg/I)	0.5
Mercury (mg/I)	0.001
Molybdenum (mg/I)	0.07
Nickel (mg/I)	0.02
Nitrate (mg/I)	50
Nitrite (mg/I)	3
Selenium (mg/I)	0.01
Uranium (mg/I)	140

Consumer
Acceptability level

Aluminum (mg/I)	0.2
Chloride (mg/I)	250
Hardness as Ca CO_3 (mg/I)	500
Hydrogen Sulphide (mg/I)	0.05
Iron (mg/I)	0.3
Manganese (mg/I)	0.1
pH	6.5 . 9.5
Sodium (mg/I)	200
Sulphate (mg/I)	250
Total dissolved soilds (mg/I)	1200
Zinc (mg/I)	4

TABLE 4.3 ACCEPTABLE LEVELS OF CHEMICALS IN DRINKING WATER

Indication	Acceptable level	Effect above level
Acidity	Above pH 7.0	Alkaline
Acidity	Below pH 7.0	Acidic
Aluminium	0.15 ppm	Deposits
Ammonia	0.02 ppm	Pollution
Calcium	200 ppm	Hardness*
Carbon dioxide	10 ppm	Corrosion
Chlorides	250 ppm	Salt taste
Chlorine	0.2 ppm	Taste
Colour	20 Hazen units	Visual
Detergent	1 ppm	Pollution
Fluoride	1 ppm	Mottled teeth
Iron	0.2 ppm	Taste
Lead	0.1 ppm	Poison
Magnesium	125 ppm	Hardness*
Manganese	0.2 ppm	Deposits
Nitrites	0 ppm	Pollution
Nitrates	10 ppm	Toxic
Oxygen	1.0 ppm	Pollution
Phenol	0	Taste
Phosphates	1.0 ppm	Pollution
Silica	20 ppm	Scale
Sulphite	250 ppm	Taste, diarrhoea
Total dissolved solids (tds)	500 ppm	-
Turbidity (tss)	5 Hazen units	Visual
Zinc	15 ppm	-

*Hardness: 0.50 ppm, soft
50-100 ppm, moderately soft
100-150 ppm, slightly hard
150-250 ppm, moderately hard
over 250 ppm, hard

High nitrate figures over 2 ppm indicate decomposition of organic pollution.

4.1 DISCUSSION OF RESULTS

This section of the work will deal with the analysis of the results obtained from the laboratory of the eight samples of water obtained from Jabi dam.

The objective of this chapter is to analyse the laboratory results of the samples and compare with Health organisation standards recommended for public consumption.

4.1.1 PHYSICAL ANALYSIS OF THE WATER SAMPLES

This deals with the determination of colour, turbidity, odour and other physical factors capable of defacing the water. Physical properties of water are highly necessary in water usage for public use especially, drinking. The clearity of water to a lay-man, renders the water portable. This parameter to a large extent determines the acceptability or otherwise of the water to the consumer.

COLOUR

Colour in water may originate from organic and metallic impurities as vegetables, humus, Iron, manganese and industrial waste such as dye. They are capable of impacting colour to water supply. The colour of water affect the quality for public comsuption.

The colour of water can be determined by visual comparison with properly cellibrated glass colour disc, standard colour solution with known concentration and visual means. The method adopted here was visual means. It was observed that all the samples analysed were clear and not objectionable. The sample satisfy the recommended level by health organisation.

TURBIDITY

Turbidity is a measure of the amount of suspended and colloidal materials present in water. This may be due to inflow from the farm land or other activities beside the dam in to the water therein. Exept the sample taking from the car wash side i.e sample C which happens to be the side where young men swims, all the samples are not showing turbidity.

ODOUR

Odour depends on actual contact of the stimulating substance with the appropriate human receptor cell. The sense of odour is closely related to that of taste. In fact, it is normally correct to suggest that most taste in water are really a sensation of smell. (odour). Odour is recognised as a quality factor which affect water in several ways, either acceptability as a drinking water, aesthetics of recreational water etc.

The determination of odour was done orally on all the samples. The samples were found not to be objectionable.

APPEARANCE

The appearance of water is closely related to colour of water. A potable water is suppose to be colourless and the appearance attractive and clear according to W. H. O. standrad for drinking water. Close observation was made on all the samples collected from the dam. The sample were found to be clear and attractive with the best coming from the sample collected at the centre.

4.1.2 RESULTS OF CHEMICAL ANALYSIS OF WATER SAMPLES

Chemical characteristics tend to be more specific in nature than some of the physical parameters which depends on climate. They are this more accurately useful in assessing the properties of a water sample.

Chemical materials that may be discharged into a receiving water may be classified into organic and inorganic pollutant, where organic materials can be defined as compounds containing a carbon atoms, undesirable results from the discharge or inorganic materials including charges in the pH of water caused by salts and toxity caused by hearvy metals (Furman 1962).

Some of the elements were analysed using atomic absouption spector, flame photometry analyses, Titrimetric analysis and ultraviolent spectrometer analyser. The elements analysed are chlorine, calsium, magnesium, Iron, Sodium, Potassium, Sulphate, Nitrate, Phosphate, Bicarbonate and pH. The results are shown in the table above.

THE pH VALUE

This is the degree of acidity or alkanity contained in the sample. The pH vale of the eight samples ranges between 6.6 and 7.4. These values are found to be within the consumer acceptability level as shown in the table - above (W.H.O. 1993). This inter that acidically and alkaincally, the water from the dam is safe for drinking.

CONCENTRATION OF IONS DETERMINED IN MG/LT

CALCIUM ION CONCENTRATION Ca++

Calcium is a very common environmental pollutants. The highest concentration of calcium was recorded at point A which is behind the block industries and point D which is at the centre of the dam. In fact, the two samples each takes at the two points arecalcium ions concentrated. The recommended level of calcium ions concentration in drinking water is 200 ppm above which the water is said to be hard. The results of our analysis shows that the calcium concentration in the samples falls within the range and thus the water from the dam is portable. In fact the water according to the standard recommendation (table 4.3 above) is termed soft.

MAGNESIUM IONS CONCENTRATION Mg^{++}

Magnesium is a common water pollutant, which results totemorary hardness of water. The value of magnesium recommended by health organisation is 125 ppm above which the water is said to be hard, from the result of our analysis, the magnesium concentration in the water is within the recommended range and thus the water is portable.

IRON IONS CONCENTRATION Fe^{2+}

The presence of iron is water is a major factor that determines its portability. They arise in water when the decomposition of cans and scraps or ores of irons which are potential source dissolves in water. Also water that flows through basement rocks and lateritic soils which contains irons.

The maximum permisible limit of iron is 1.3 mg/l table 4.2 above

(W.H.O 1993). With the iron content of between 0 and 0.21 in our samples, we discover that the water is safe for consumption.

CHLORINE CONCENTRATION Cl^-

Chlorine is considered to be an important element in water because its concentration determines the susceptibility of the water to pathogens that causes some water born diseases in the system of man that consumer it. The recommended concentration of chlrine by W.H.O 1993 standard is 250 ppm above which the water is said to be salty. From the result of our analysis of the samples, the concentration of chlorine in the water from the dam is within the acceptable range, thus the water is portable.

NITRATE CONCENTRATION No_3^-

The standard recommendation by W.H.O for Nitrate concentration in drinkable water (W.H.O. 1993) from table 4.2 above is 50 mg/l. From the result of our analysis, the range of Nitrate concentration in the water samples is between 0 and 12 mg/l which shows that the water is very safe for drinking.

POTTASIUM CONCENTRATION

Potassium in water is considered to be very toxic simply because in elemental state, it reacts violently with moisture to librate hydrogen and form potassium hydroxide (KOH) which is extremely caustic in nature. The toxicity of patassium compounds in almost equivalent to that of the anion. Potassium hydroxide in highly irritating and toxic by ingestion and accidental mhalation of its compound. The permissible limit recommended by W.H.O. is 200 - 400 mg/l. Our result of the analysis of the water samples which indicates between 1.7 and 3 shown that the water from the dam is portable and free for human consumption.

SULPHATE CONCENTRATION So_3^-

Sulphate in water could be as a result of wheathering of rock that contains high percentage of sulphate compound, lateritic soils as a result of fertilizer application and delayed organic matter. The sulphate concentration of between 6.7 and 32 mg/l in our sample analysis falls within the range of 250 mg/l recommended by W. H. O. in 1993 (table 4.2). The water is therefore safe for drinking.

BICARBONATE CONCENTRATION HCo_3

The results of our analysis of the water samples shows a range of between 3 and 24 concentration. This is very reasonable considering the 500 mg/l specified by W.H.O. standard.

SODIUM CONCENTRATION Ma^{2+}

The sodium ion concentration in the result of our analysis of the samples from the dam indicates a range of between 3.4 and 10. This shows that the water is safe for drinking as the W.h.O standard is 200 mg/l (table 4.2)

PHOSPHATE CONCENTRATION PO_3^-

The recommended standard for phosphate concentration in drinking water is 1.0 ppm above when the water is said to be polluted (table 4.3). The result of the analysis of the water sample from the dam which indicates record of as high as 2.6. phosphate contents shows that the water shows some level of treatment before it can be portable. This probably arose as a result of the water from the car wash flowing back into the dam as could be observed from the table 4.1 above.

HARDNESS

The hardness of the water may be as a result of the calcium carborate concentration in the sample. The W.H.O recommended standard for hardness in water containing calcium carborate Ca Co_3 is 500 mg/l. The result of our analysis of the samples which shows a range of between 21.0 and 35 is very reasonable and shows that the water is portable.

TOTAL DISSOLVED SOLID (TDS)

The total dissolved solids recommended by W.H.O (table 4.2) is 1200 mg/l. Our results shows that the water samples contains between 15 and 120 mg/l. This shows that the water is free for drinking.

DISOLVED OXYGEN

The highest content of the dissolved oxygen in the water samples is 4mg/l. This is fair enough when compared with the standard recommendation of 1 ppm (table 4.3).

BACTERIOLOGICAL ANALYSIS RESULTS

While a chemical examination is necessary for the purpose of detecting poisonous or corrosive substance in the water sample, for determining the effects it will have on public use, chemical test can not show the presence or absence of pathogenic bacteria. hence it has to be accompanied by bacteriological examination in order to get a full picture of the true quality of this water.

This test is carried out to detect the presence of oranism called coliforms. The presence of coliforms indicates that the water is contaminated.

The standard recommendation of health standard is 10 -25 per 100ml coliform contents of the water in the dam is high and thus renders it unfit for drinking. Therefore futher treatment of the water to remove the coliforms will have to be carried out before the water can become protable.

CHAPTER FIVE

5.0 OBSERVATION RECOMMENDATION AND CONCLUSION

5.1 OBSERVATION AND RECOMMENDATION

From technically point of view, it has been abserved that most of our surface water supplies are of satisfactory quality for drinking just with mininal treatment given to them.

The water in Jabi dam is of good chemical quality and infact, one of the best around. With minimum standard treatment of the water it will be perfectly pass for a portable water.

However the bacteriological aspect of the water has to be well taken care of. One will see that the presence of coliforms in the water is as a result of the faces and other impurities as mentioned in chapter 3, which are being allowed into the dam. This is due to the unrestructed access that people are having to the dam.

The P.H of the water is very adequate and the water in the dam is soft. One would like to recommend that the access to the dam be restructed by building wall round the edges of the dam to barricade it from the neighbouring developments and residential areas. All the illegal occupants of the banks e.g. The car washmen, the block industrialists etc, should be pursued out of the place and the legal occupants like the hotel should be stictly warned not to chemical effluent and waste from their hotel to the dam again, after all Abuja has a central sewage system and serve lines and chambers are provided everywhere in the miniciparlity. Let the hotelier locate the one nearest to the place and connect the wastes from the hotel to the sewer line.

There should be adequate security around the dam evertime to prevent the swimmers, fishermen, local washermen etc, from gaining entance to the dam.

5.2 CONCLUSION

Contrary to the widely held belief at the Abuja water board that the increament in human activities around the dam has made the quality of the water in the dam to be so polluted that the amount of water the dam will yield daily will not insity the amount of money that would be spent on the treatment of the water before it becomes portable, the result of the laboretory analysis of the samples take from different points on the dam has shown that the water only need minimal chemical treatment for it to be become drinkable. The biological / bacteriological aspect of the pollution in the dam can be prevented using the method recoomended above if the political will to make use of the dam for the supply of waterto Abuja metropolis as originally purposed is re-arra-kened, the dam can preform the intended function.

At this period which the development of Abuja is exploding every day and the population growth is getting astronomical with the attendant stress on the available intracstructures especially water, the government should expedite action on revauping Jabi dam so that it can suplunent lower Usuma dam in the supply of portable water to the metropolis and the surrounding satelite towns. It is possible.

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