# ASSESSMENT OF THE TREATMENT AND POLLUTION LEVELS OF THE WATER IN BOSSO DAM, MINNA

BY
*UMAR MOHAMMED AUDU*
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# DECLARATION

I hereby declare that this thesis has been written by me and that it is a record of my research work. Addition information were derived from the published and unpublished work of others and they are specifically acknowledged.

24-09-2001

UMAR MOHAMMED, AUDU

# CERTIFICATION

The research has been carefully read through and approved as meeting the requirement of the Department of Geography, Federal University of Technology, Minna, for the award of PGD, Environmental Management.

Dr. G.N. Nsofor
Project Supervisor

13/11/2007
Date

Dr. M.T. Usman
Head of Department

14/11/2007
Date

External Supervisor

Date

# DEDICATION

This project work is dedicated to late Aishat, late Dantala Hassan Kwali, late Musa Abdullahi (Accord) and Umar Mohammed, Salihu and his family for their understanding support and encouragement. And to Allah Almighty for his guidance and substainance now and always.

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# ABSTRACT

This project is aimed at assesing the treatment and pollution levels of the water in Bosso Dam, Minna.

Considering the significance of water to man both for drinking, domestic and industrial purpose, it is essential to test and know the quality of water used by the populace in an area, so as to avoid using contaiminated and polluted water, which is so detrimental to human life and other animals.

As such many of the parametres written in this work whose experimental analysis were carried out in laboratory were given, while those that have not been successful, only the literature review of them are considered.

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# CHAPTER ONE

## 1.0 INTRODUCTION

BACKGROUND TO THE SITUATION:-

Man's survival over the surface of the earth has always been dependent on water availability. From time immemorial, availability of water was an important aspect of human location. This explain why KNOGHT (1989) said that the natural rivers have always been at the centre of civilization. He also observed that communities have often built structures to conserved water for their use.

For over 4,000 years civilization grew up along the rivers valley in Egypt, mesopotamia, and India. Man learned that pollution, flood and draught affect his well being, and so he began to build earth rock-filled and stone dams to store water for later use, to divert water for growing his crops and to protect the land and people from disasters which might arise from pollution. In those days early civilizations knowledge of dams technology and control of water resources strongly influenced the rise and fall of cultures.

In the 20th century the art of dam building advanced rapidly, spurred by advances in construction equipment the use of concrete and science and soil mechanics. As a result, dam increase rapidly. Hence it is clear that exploration of water resources as always, even thought the historic time is for creating a more favourable environment for the conduct of man or human affairs. In long time, one of the most important problems facing the world is the provision of adequate supply of fresh water for industry, agriculture and for the substance of life of man. Inherent in this problem is the avoidance of pollution and waste. Pollution especially of water is basically a global problem a concern, mostly in the developing countries e.g. Nigeria. Water

In Natural ecosystems it is always receiving certain amounts of foreign substance which are diluted or filtered out through natural processed. When the input becomes so great that natural process can not control it, we say that pollution has occurred. The California state water quality control board defines pollution of water as "Any impairment of its quality that adversely and Unreasonably affects the subsequent beneficial uses of such water "

Water pollution include presence of disease – producing (pathogenic) bacteria and viruses (biological pollution) and of undesirable ions and compounds in solution (chemical pollution). Also presence of suspended substances causing turbidity may be included as forms water pollution.

Thermal pollution of water, a form of energy infusion, raise the quality of sensible heat in those fluid to abnormally high levels.

All natural water, even when not polluted by man are impure since they contain absolved substances, rain water contain dissolved gasses as impurities, the impurities in the water on the earth surface depends upon the nature of the soil and rock over which it has passed in addition to natural contaminant in water, many pollutants are being added to our water by man. For the time being neither the magnitude nor the existence of the problems created by these pollutant was realize and unfortunately only very little is known of the possible effects on human health of the largely unidentified chemical substance that enter our water supply success.

Several important water supply that are now causing concern include phosphate which have being used widely as water softener in laundry detergent have been release in large quantity into rivers and streams through water. Further more, fertilizer contains phosphate, in addition to that found in certain rocks, so that , additional phosphate reaches the dam through stream and rivers via run off.

## 1.10 STATEMENT OF RESEARCH PROBLEMS

Pollution has been a major environmental hazard causing extensive damages to lives-human, Animals and even plants to some extent.

A long time before now people living in the settlements sorrounding Bosso have depended on Bosso Dam for supply of water for their domestic needs, to sustain animals and even for micro imigration activities. With the passage of time, the pollution of this area has blown to outweight the carrying capacity of this Dam. The state waters Board is not giving sufficient attention to the sustainance and treatment of the water, the natives too are not helping matters, they breach the usual or ordinary laws and take their cattle directly to the dam, thereby getting the water polluted forgetting that 'water is life shortage supply of it, non availability of it or it presence in conterminated form is a danger to the survival of life" Nakada (1969).

## 1.20 AIMS AND OBJECTIVES

The aim of this research project is to attempt an assessment of the levels of treatment and pollution water in the Bosso Dam.

To achieve this objective we have tried to identify the major pollutants of this water. Also we have identified whether the required chemical for the treatment are added in required quality and quantity.

To also see whether the pollulation has any effect on the dam and to what extent and what can possibly be done to sustain the dam.

## 1.30 JUSTIFICATION OF THE STUDY

Despite the presence of this dam in Bosso, the inhabitants buy water at more exhoibitant rate than garri and or fuel word. In addition to drinking, water is required for many things viz domestic and industrial when this is not met then lives are in danger.

Water is not only required in large quantity but also in standard quality, Here even when the water is seen and sold at cut throat prize the quality is below standard thereby making peoples lives valnurable to water related disease.

## 1.40 THE STUDY AREA

The area of study is Bosso Dam which has latitude 9°N and 10°N spreading longitudinally between 6° - 7°30' East of Greenwich Meridian and less than four kilometers away from Minna Northward.

## 1.50 CLIMATE

The tropics are characterized by two predominant seasons. In the dry season, the cool dry harmattan winds blow across the desert plain into interior of the savannah where Bosso Dam lies. This coupled with the high radioactive power of the insolation causes high drying ofthe entire area, soil dessication and erosion. The casuative amass is called tropical continental or North easterly flow, and occurs between the month of oct. febuary.

However, the south westerly (tropical maritime) flows as a warm, Moist humid air mass bringing rains from the Atlantic ocean, across the forest belt into the savannah.

It is estimate that annual rainfall in this area is between 1120mm - 1300mm (NSWB 1990).

## 1.60 SCOPE AND LIMITATION

This research project is limited to assessment of pollution level and treatment of water in Bosso Dam.

There are littel or no data in respect of this dam. Though the dam is still in use, but to some extend and at the moment there is no attention focused to it hence the difficulty to get material for the research.

## 1.70 ORGANISATION OF THE THESIS

Chapter One: INTRODUCTION

(i) Statement of research problem

(ii) Aims and objectives

(iii) Justification of the study

(v) Study area and its climate

(iv) Scope and limitation

(vi) Organisation of the content

Chapter two: Review of other work on

General assessment of water quality and pollution

Chapter three: Methods used Data collected and analysis.

Chapter four: Results and findings

Chapter five: Summary and Recommendations.

# CHAPTER TWO

## 2.10 SOURCES OF WATER POLLUTION

The basic sources of water pollution can be as a result of natural causes and man's activities. Our land air and sea are being showly poisoned by the toxic substances used and produced through human activities such activities include agriculture, industry and subsequent refuse dumping. Harmful substances leak into the ground through dumping on lands and seas and disposing of them by bourning simply creates new chemical that pollute the air.

Land pollution is as a result of indiscriminate dumping of waste matters on the surface of the earth. This includes agricultural waste, domestic refuse, waste from mining and querring, sewage deluage, industrial waste, oil and demolition debris. All these are carried in one way or the other into the river. The pollution of water has constituted a very bog concern in the environment today since it has very serious detrimental effects on the aquatic lives and human being at large. The sources of water pollution arise as a result of improper management of waste and more so man in search of technology, land fills which eventually release toxins into the underground and surface water. Surface water is conterminated through the run off wastes from land fills or waste dumps into a stream or river or in another land or direct disposed of waste unto a body of water.

Most industries discharge their waste directly to the river. Companies dump or discharge their waste directly to the stream or rivers. This delibrate action has caused or resulted in environmental deterioration. Water pollution or impare water has been the leading cause of fatal disease in man.

Such water-borne disease include typhoid fever, dysentary which have come more serious at present especially in the industrial cities e.g. Kaduna, lagos, portharcourt, warri e.t.c.

## 2.20 AGRICULTURE WASTE

One major source of water pollution has come from agriculture through new methods of farming. It has been asserted repeatedly that agriculture may be, if not the most major cause of pollution (Gondie 1980)). The application of fertilizer has caused a serious problem to the aquatic lives as it constitute pollution problem to the water. Inspite of the advantages we have derived from farming, it has also become a problem. The application of fertiliser to the soil has assisted in enrichment of utrogen and phosporate in the river thereby causing a problem called entrophication. This has brought a depletion of oxygen in the river. Also, the introduction of these chemicals into the sea and rivers through run off has led to the growth of algae which is now anther alarming problems. It has also been reported that consumption of excess nitrates in water could lead to health hazards to humans and animal, when these water is consumed raw without proper treatment.

Another major source of pollution brought about by agriculture is the wrong application of pesticides. These are various brands of pesticides and they differ greatly in their mode of action, the duration of time they remain in the brosphere, and in their toxicty. The most adverse criticism of pesticides has been directed against the chlorinated dydro carbon group (CIIG) of pesticides which include DDT and Dieldrin. These insecticides are toxic not only to the target organism but other insects too. They are highly persistend and appreciable quanitiies of the original application may survive inthe environment in unaltered form for years. This too can

have rather severed effects global dispersal amongst other problems. The herbicide is a type of pesticide, used to eliminate harbs. This does not only affect the target rather the non-target. The farmer used them to fight the weeds that are undesirable in the farm. Herbicides are harmful when they are transported to the nearby rivers and stream. Though they serve a purpose for which they are called for, but their harmful effect remain. These chemicals constitute a problem of pollution even in the environment. They are harmful to the body tissues when consumed by man and could result on death (Boltz 1978). Its removal from the environment and river huge expenditure.

2.30 WATER POLLUTION: Water pollution is frequently undersirable. It causes disease transmission through infection; it may poison man and animals; it may create objectionable odours and unsightliness; it may be the cause of the unsatisfctory quality of even the treated water.

The causes and form of water pollution created by man are many and can be classified into group namely sewage and wastes, infections agents; organic chemical, in organic and mineral substances twibility (sediments); radio active substance and heat (thermal pollution), many of mans activities can contribute to changes in water quality, including agriculture, fire urbanisation, industry, mining, irrigation, and many important some pollutions merely have local effects while otheres such as acid rain or DDT may have continental or planetary applications

In Nigeria long -term records are sperse, gauging stations have often been moved, analytical methods change, and some trends in water chemistry may be due to natural factors rather than to man.

It is not a simple matter to try to estimate the global figure for the extent of water pollution that man him caused for one thing or knowledge is insufficient about the natural long term levels of dissolved materials in the world's river. However, some recent studies do give some general indication of the likely impact. For instance, it is estimateed that about 500 million tonnes of dissolved salts reach the ocean each year as a result of man activities. These inputs have increased, chloride and sulphate and have created an overal all globak augmentation of river mineralization by about 12% (Gophe, 1930).

Water pollution of servage provide one of the classic example of the diseconomics of scale acompanying population growth if a few people per mile or per kilometeres live along large river their sewage may be dumped directly into the river and naturally purification will occur. However, if the population increase the waste degrading ability of the river become over strained and either the sewage or the intake water must be treated if the river water is to be safe for drinking, should the population along the river increase further, more and more elaborate on expensive treatment will be required to make the water safe for human use. As the population in big cities grow so does industries which pours it on water supply a vast array of contaminant; lead, detergent, sulphonic acid, hydrogen flowride, phenols, eithers, benzene, ammonia and so on. As the population grow, so does the need to increase agric production which results in a heavier water borne load of insectrocide, herbicides and nitrates (from fertilizer). With the spread of population goes the traits of epidemic of hapatitis and dysentary, and poisoning by

exotic chemicals.

Oils spills in tranportation pipeline and tankers also cause river pollution. Thermal pollution aggregate other water pollution in two ways; It increase the rate of oxygen consumption of aquatic organism while lowering the actual dissolved oxygen content of the water, thus reducing the amount of waste that biological system in the water way can degrade, it also increase the rate of evaporation which raises the concentration of pollution that are left behind (Michael, 1982).

Another source of water pollution is through road side mechanical workship during the process of work on the vehicles there is huge amount of oil used. At times the discharge from vehicles constitutes environmental hazard. The expired oil are drained from vehicles and pour into any gutter from where this dark-coloured oil flow into the river.

Cattle grazing along the river does not only bring increase in nutrients, it produces a physical changes in the colour of the water. It also contributes to a major cause of gastro intestinal deseases when the water is taken without treatement it may lead to the eradication of aquatic lives as well as posing danger to human lives.

Quite a number of other work are reviewed so as to understand the problems of water pollution and assessment of treatment levels both in Nigeria and other parts of the world. The essence of the review is to gain some experience on the methodology of handling such problems. Such experience have been translated into some of the methodology utilised in this thesis and discussed in the next chapter.

# CHAPTER THREE

## 3.0 METHODOLOGY

## 3.10 IMPORTANCE OF PARAMETERS TO BE DETERMINED

## 3.20 DETERMINATION OF PH:

The following were the materials used to source information on the PH level of the water;

i. PH meter (Battery operated) Gripfin.

ii. Combination Glass-calonel electrode, Gallen Kaneo.

iii. 500ml beaker

iv. Magnetic stirrer

### PROCEDURE

The electrode was standarlised in buffer solution of PH 6.0 and 10.0. Then buffer solution break the expected PH range of the test samples. Then there was washing of the electrode after e4ach immersion into the solution under test to prevent contamination of the test samples and the buffer solutions. After used, the electrode was then stored in a buffer solution of PH 7.0. The PH meter used in this work was not adapted to temperature regulation. Full and summarised result are shown in the next chapter.

## 3.30 DETERMINATION OF CONDUCTIVITY

The following were the material used to source information in the conductivity of the water.

MATERIALS: Electrolytic conductivity measuring set model, MC -1, mark V, 5013 model.

PROCEDURE: The cell was cleansed thoroughly rinsed with deionised distilled water followed by the sample measured.

The cell was then filled with the sample and the connecting cable plugged intot he "measuring cell" socket. The activator buttom was pressed down and the measuring dial slowly rotated unitl the balance indicator moved to the centre scale. The dial setting at which this occured was read and multiplied by the range factor. The result was the specific conductivity of the sample in $rcsm^{-1}$.

## 3.40 DETERMINATION OF SOLID MATTER

The following were the materials used to source information on the solid matter level of the water sample.

MATERIALS

i. Porcelain evaporation dishes $100cm^3$ capacity and 90mm diameter.

ii. Steam batin

iii. Drying oven equiped with a thermostatic control capable of maintaining the temperature with a $20^c$ range.

iv. Dessicator containing silicagel dessicant.

v. Analytical balance, 100g capacity capable of weighing 10 0.1mg.

PROCEDURE

Clean porcelian evaporation dishes were kept in an oven set at 103° - 105°c and weighed. $25cm^{-3}$ portion of the sample was piped into a dish and evaporated sample was then dried in the oven at 103° - 105°c for 1 hour.

This was colled in a dessicator and weighed. The process of drying, cooling in a dessicator and weighing were repeated until a constant weight was obtained. Triplicate determination were carried out simultanenously for each sample and average results were used in the calculation.

## 3.40 DETERMINATION OF CHLORIDE

The following were the materials used to sources information on the chloride level of the water samples investigated.

MATERIALS:

i. Mohr

ii. Mecury nitrate

iii. Ferricyanide method

The argentometric methods is suitable for relatively clear waters and was the procedure adapted for this work. The method avail itself of the well known reaction of silver salts with soluble chlorides. When a solution of the nitrate of silver is mixed with a salution containing

chlorides, the sparingly soluble silver chloride is produce and the quantity of chloride in water may be determine by ascertaining how much of a standard solution of silver nitrate is required, in order to precipitates all the chlorides in a certain volume of the water sample. These test were carefully carried out repeatedly for a period of six weeks in order to obtain a realistic results on the basis of which good judgement could be passed for achievable recommendation.

The standard for both raw and treated water of Nigeria as well as the world health organisation (WHO) is provided in appendix I and III. These standards were used to compare with the result observed, conclusion and recommendations were drawn.

On each sampling, the enalysis were determined thrice to obtain reproducible resuilts. The results obtained were used to discuss and draw conclusions.

# CHAPTER FOUR

## 4.0 RESULT AND FINDINGS

The following tables are detail results of test of raw water from Bosso dam and treated water from Bosso water works.

Also the summarised result appreared as table 4:7 and table 4:8. The various determinant have been investigated and the results obtained. It is clearly explained in the discussion.

Table 4:1 RESULTS OF PH

| WKS | BOSSO DAM RAW | BOSSO WATER WORKS |
|---|---|---|
| 1st | 6.80 | 7.08 |
| 2nd | 7.10 | 7.30 |
| 3rd | 6.90 | 7.40 |
| 4th | 7.40 | 7.60 |
| 5th | 7.60 | 7.80 |
| 6th | 7.10 | 7.70 |
| P/A | 7.15 | 7.48 |

Table 4:2 RESULTS OF CONDUCTIVITY ($rscm^{-1}$)

| WKS | BOSSO DAM RAW | BOSSO WATER WORKS |
|---|---|---|
| 1st | 90 | 95 |
| 2nd | 95 | 100 |
| 3rd | 100 | 100 |
| 4th | 85 | 100 |
| 5th | 90 | 95 |
| 6th | 90 | 95 |
| P/A | 102.2 | 106.2 |

Table 4:3 SOLID MATTER (PPM)

| WKS | BOSSO DAM RAW | BOSSO WATER WORKS |
|---|---|---|
| 1st | 1200 | 560 |
| 2nd | 1016 | 513 |
| 3rd | 980 | 407 |
| 4th | 1164 | 401 |
| 5th | 1020 | 388 |
| 6th | 1100 | 412 |
| P/A | 1080 | 447 |

Table 4:4 RESULT OF CHLORIDE

| WKS | BOSSO DAM RAW | BOSSO WATER WORKS |
|---|---|---|
| 1st | 12.3 | 14.6 |
| 2nd | 10.4 | 12.3 |
| 3rd | 11.7 | 11.8 |
| 4th | 6.8 | 10.9 |
| 5th | 8.3 | 11.2 |
| 6th | 11.4 | 11.6 |
| P/A | 10.2 | 12.10 |

Table 4:5 NITRATE (PPM)

| WKS | BOSSO DAM RAW | BOSSO WATER WORKS |
|---|---|---|
| 1st | 23.6 | 20.4 |
| 2nd | 22.1 | 20.7 |
| 3rd | 19.7 | 18.3 |
| 4th | 20.6 | 20.1 |
| 5th | 19.8 | 19.1 |
| 6th | 23.4 | 18.4 |
| P/A | 21.5 | 19.5 |

Table 4:6 CALCIUM (PPM)

| WKS | BOSSO DAM RAW | BOSSO WATER WORKS |
|---|---|---|
| 1st | 16.3 | 11.30 |
| 2nd | 12.7 | 11.20 |
| 3rd | 14.8 | 14.7 |
| 4th | 14.6 | 12.6 |
| 5th | 13.1 | 12.8 |
| 6th | 12.8 | 13.0 |
| P/A | 14.10 | 12.60 |

## 4.0 RESULTS

The various determinants have been investigated and the results obtained. Detail results of the complete analysis are shown in 4:1 - 4:6. The results are also summarised in the table 4:7 for each determinant through out the period of investigation in the formation of the tables, the water from the Bosso treatement plant and Bosso Dam are considered separetely as shown.

Table 4:7 SUMMARISED RESULT OF QUALITY OF RAW WATER FROM BOSSO DAM

| DETERMINATION | MAXIMUM | MEAN | MINIMUM |
|---|---|---|---|
| PH | 7.60 | 7.15 | 6.80 |
| Conductivity at 27°c($rscm^{-1}$) | 100 | 102 | 85 |
| Total solids | 1200 | 1080 | 980 |
| Calcium | 16.3 | 14.10 | 12.7 |
| Chloride | 12.3 | 10.2 | 6.8 |
| Nitrate | 23.6 | 21.5 | 19.7 |

Table 4:8 SUMMARISED RESULT OF QUALITY OF TREATED WATER FROM BOSSO TREATMENT PLANT

| DETERMINATION | MAXIMUM | MEAN | MINIMUM |
|---|---|---|---|
| PH | 7.80 | 7.50 | 7.1 |
| Conductivity at 27°c(rscm$^{-1}$) | 100 | 10.6 | 95 |
| Total solids | 560 | 447 | 388 |
| Calcium | 14.7 | 12.60 | 11.20 |
| Chloride | 14.6 | 12.70 | 10.9 |
| Nitrate | 20.7 | 19.5 | 18.1 |

## 4.20 FINDINGS

Bosso Dam is very important to the socio-economic life of the inhabitants of Bosso town. The people and the sorrunding settlements make use of the water for both drinking and domestic purposes. The inhabitants were found washing their wares and collecting water of and they confirmed on enquiry as drinkable. According to sources, they drink the water only during dry season (due to scarcity). Also on the extreme side of the dam, it is noticed from time to time that herds of cattle dwell around. Also, observed along the banks are animal excretes, dead plants and felled trees. The water itself varied from point to point, but generally contain a lot of silt thereby rendering it turbid on collection, the water appeared turbid and objectionable but on studing, becomes relatively clear and perhaps unobjectionable. The dam is old with so much clay. A particular side where the inhabitants use to collect water was selected the sampling point. The water from the Dam is sent to the Bosso treatment plant through a pipe. A very important point to note is that at the treatment plant, the water is simply allowed to stand for hours (to

allow for sedimentation to take place) before chemicals-mainly alum, soda and bleaching powder were added.

The finding are hereby presented in respect to each determinant.

## 4.21 PH

The PH of the sample analysed range from 6.80 to 7.60 with a mean value of 7.15 for raw water from the Dam, and 7.10 to 7.80 with a mean value for treated water.

The PH value observed are within the highest desirable limit recommended by the would health organisation.

## 4.22 CONDUCTIVITY

The conductivity of the sample analyses ranged from 85.0 to 100 $rscm^{-1}$ with a mean value of 102 for Bosso dam and 95.0 to 100 with a mean value of 106 for the treated water.

Nearly all the values recorded for the raw water samples for the dam are lower than the corresponding values from the treatment plant. This is because more substances responsible for ionic conductance go into the water during treatment.

## 4.23 TOTAL SOLIDS

The amount of solid matter present in the water rendered the water turbid and unhealthy for human consumption. The total solids of the sample analysed range from 980 ppm to 1200ppm with a mean value of 1080ppm for Bosso dam, and 388 ppm to 560 ppm with a mean value of 447 ppm for the treated water.

The standard for drinking water quality of Nigeria recommend that the total dissolved solids in water should be below 500 ppm and maximum permissible level of total dissolved solids should not exceed 1500 ppm.

It has been stated that solid matter if present in water may impart taste to the water and may induce gastro intestinal limitation (Dix 1981).

## 4.24 CALCIUM

The calcium level of the samples analysed range from 12.7ppm to 16.3ppm with a mean value of 14.10 for Bosso dam, 11.20ppm to 14.70ppm with a mean value of 12.60ppm for treated water.

The value obtained are within WHO recommended level (see appendix II).

## 4.25 CHLORIDE

The chloride level of the sample analysed range from 6.8ppm to 12.3ppm with a mean value of 10.2 for the Bosso dam. For the treated water form the treatment plant, the sample analysed range from 10.9 to 14.6 with a mean value of 12.10.

The values obtained are within the recommended limit of WHO standard.

## 4.26 NITRATE

The nitrate level of the sample analysed rnaged from 19.7 to 23.6 with a mean value of 21.5ppm for raw water from Bosso dam and 18.1 to 20.7 with a mean value of 19.5ppm.

The WHO recommends that nitrates levels in water should not exceed 45ppm. Throughout the analysis, the values obtained are below the recommended limit. These values are quite high, and are indicators of pollution.

# CHAPTER FIVE

## 5.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

It has been stated that the chemistry of water can lead to disease either if there is an absence of necessary constitutent or, more commonly if there is an excess of a harmful chemical (micheal 1982).

This elicited the interest to do this project in doing, this water was collected from Bosso Dam (Raw) and another from Bosso treatment plant (treated).

With the consideration of various agents of water pollution, the samples collected were taken to the laboratory to determine the level of pollution and the effectiveness of the treatment to compare it to the quality recommended for Nigeria as show in appendix I.

The analysis specifically sought to identify the level of solid matter, PH, chloride, nitrates, conductivity and calcium and compare it to recommended quality.

It is evident from from the findings that Bosso dam is gradually accumulating substances. This is affecting it's quality. For all the parameters analysed, the value obtained are within the recommended limit of the standard for water quality in Nigeria.

However, the higher values of nitrate and total residue is of much concern. These high amount of nitrate observed could indicate pollution. This could be through farming activities where NPK (Nitrogen, phosphate and potassium) fertiliser is excessively and wrongly applied. Also, contamination with sewage and refuse dumps could lead to high nitrate level. The high total residue in the water may impart taste to the water and may induce gastro intestinal invitation.

## 5.20 RECOMMENDATION

Water is life-shortage supply of it, Non availability of it or it presence in conterminated form is a danger to the survival of life "(Nakada 1969).

It is on the basis of our findings and of course the importance of water as emphasise by Nakada that I draw the following recommendation.

It has been emphasized that several sicknesses including typhoid, cholera are related to pattogens excreted in the facess of a carrier. There is therefore, a circular link between the prevalence of such diseases and the discharge of untreated sewage. Government should therefore discourage the dumping of refuse in river, bank and around the dam.

Agriculture activities around the river area or the dam should be legislated against.

Proper attention should be focused on the treatment plant to ensure release of only treated water because the test indicated some irregularity which suggest that in some occasion, the water does not get correct dose of the required chemicals for treatment.

People washing close to the dam should be discouraged.

Cattle rearing along the dam site should attract a penalty of prision time with the aim of maintaining clean water for all.

It is evident today that as at the time the dam was constructed it was meant to cater for fewer people far less than what it is sustaining now. During the projection the federal university of technology was a mere teachers training college with less than five hundred students, there was neither Bosso Estate nor Bosso lowcost, the new extension at the back of the university was not also taken into consideration. Also, there is massive expansion of Bosso town toward Bahago Secondary School and at the opposite side towards Berger camp which was not considered. It

is on this basis that I recommend a total overhaul of the dam in terms of expansion and general rehabilitation to accomodate the super population which is growing with the passage of days.

I would also call on the Bosso Local Government Area and especially the Niger State government to liase and evolve a government/community special committee which would from time to time monitor and advice the government on how to preserve and protect the dam for posterity.

The need to employ a professional chemist and a water resource manager with an office at the dam site cannot be over emphasise and there cannot be a better time than now.

It is my conviction that if these recommendations are adapted, the dam can serve it purpose now and always for this generation and generations to come.

10. and magnesium in Canadian drinking water supplies" Environmental science Technology, 15, pg 707 – 713.
11. World Health Organisation (1958) " International standard for drinking water " 2nd Edition, Geneva pg 104.

# APPENDIX (I)

## STANDARD FOR DRINKING-WATER QUALITY IN NIGERIA (2)

1.0 RAW WATER:

1.1 GENERAL: No source shall be approved until a sanitary survey has been carried out.

1.2 PHYSICAL: The limiting value for colour be 300 units unless special treatment processes to create this is to be provided.

1.3 CHEMICAL:

1.3.1 SUBSTANCES AFFECTING PORTBILITY

| ITEMS | MASS ALLOWABLE ($mg/dm^3$) |
|---|---|
| Total dissolved solids | 1,500 |
| Chlorides | 600 |
| Iron | 50 |
| Manganese (assuming that ammonia content in less 0.5 $mg/dm^3$) | 5 |
| Copper | 1.5 |
| Zinc | 1.5 |
| Manganese plas sodium sulphate | 1,000 |
| Alkyl. Benyzyl Sulfonates (ABS: Surfactants). | 0.5 |

* This value has been established on the basic of the maximum sensitivity of the presently accepted analytical procedure.

### 1.3.2 SUBSTANCES AFFECTING HEALTH

| ITEM | MASS ALLOWABLE ($mg/dm^3$) |
|---|---|
| Nitrate as $No_3$ | 4.5 |
| Flouride as F | 4.5 |

### 1.3.3 TOXIC SUBSTANCES:

| ITEM | MASS ALLOWABLE ($mg/dm^3$) |
|---|---|
| Phenolic substances | 0.002 |
| Arbenic | 0.05 |
| Cadmium | 0.01 |
| Chromium | 0.05 |
| Cyanide | 0.02 |
| Lead | 0.05 |
| Selenium | 0.01 |
| Mercury | 0.001 |

1.3.4 CHEMICAL INDICATOR OR POLLUTION

| ITEM | MAX.LIMIT OF POLLUTION ($mg/dm^3$) |
|---|---|
| Chemical oxygen demand (COD) | 10 |
| Biochemical Oxygen demand (BOD | 6 |
| Total Nitrogen exclusive of No $NH_3$ | 1 |
| Carbon chloroform extract (CCE: organic pollution)* | 0.5 |
| Grease | 0.5 |
| | 1.0 |

Any amount greater than 0.2 indicates the necessity for further analytical determination the causative material.

BACTERIOLOGICAL

| CLASSIFICATION | COLIFORMS\100CM³* |
|---|---|
| terial quality applicabl to | |
| nfection treatment only | 0 - 50 |
| erial quality requiring conventional | |
| nods of treatment (coagulation, | |
| ation, disinfection). | 50 - 5,000 |
| vy pollution requiring extensive | |

| | |
|---|---|
| types treatment. | 5,000-50,000 |
| Very heavy pollution, unacceptable unless special treatments designed for such water are used; Source to be used only when unavoidable | 50,000 |

* Where more than 40% of the coliform are found to be of faecal coliform group, the water should be considered to fail into next highest category with respect to the treatment required.

2.0 TREATED WATER:

2.1 PHYSICAL: Highest desirable and maximum permissible levels of physical properties affecting potability.

| PROPERTY | HIGHEST DESIRABLE | MAXIMUM PERMISSIBLE |
|---|---|---|
| Colour | 5 units | 50 units |
| Turbidity | 5 units | 25 units |
| Taste | Unobjectionable | |
| Odour | Unobjectionable | |
| PH range | 7.0 - 8.5 | 6.5 - 9.2 |
| Chloride (cl) | 200 | 600 |
| Magnesium + sodium sulphate | 500 | 1,000 |

| | | |
|---|---|---|
| Phenotic compounds (as | | |
| phenols | 0.001 | 0.002 |
| Carbon chloroform extracts | | |
| (CCE, organic pollutants) | | |
| Anionic Detergents | 0.2 | 1.0 |
| mineral oil | 0.01 | 0.3 |

* Concentration greater than 0.2 mg\dm$^3$ indicate the necessary for further analysis to determine the causative agent.

# APPENDIX II

## WHO INTERNATIONAL STANDARDS FOR WATER, 1971 (20)

MAXIMUM PERMISSIBLE LEVEL ($g/m^3$)

| SUBSTANCE | FOR DOMESTIC USE | FOR DRINKING WATER |
|---|---|---|
| Arsenic (as As)* | - | 0.05 |
| Calcium (as Ca)+ | 200.0 | - |
| Cadium (as Cd)* | - | 0.01 |
| Chromium (as Cr)* | 0.05 | - |
| Copper (as Cu) | 15 | - |
| Iron (total Fe) | 1.0 | - |
| lead (as Se)* | - | 0.1 |
| Magnesium (as Mg) | 150.0 | - |
| Manganese (as Mg) | 0.5 | - |
| Mercury (total Hq) | - | 0.0001 |
| Selenium (as Se)* | - | 0.01 |
| Zinc (as Zn) | 15.0 | - |
| Ammonia | - | 0.5 |
| Anionic detergent | 1.0 | - |
| Chloride (as Cl) | 600.0 | - |
| Cyanide (as CN)* | - | 0.05 |
| Flouride (at 10-12°c)+ | - | 1.7 |
| Mineral oil | 0.3 | - |

| | | |
|---|---|---|
| Nitrate (as $No_3$)+ | - | 45.0 |
| Total nitrogen (exclusive of $No_3$) | - | 1.0 |
| Phenol* | 0.002 | - |
| Polynuclear aromatic hydrocarbon (PAH) | - | 0.2 |
| Sulphate (as $S0_4$) | 400 | - |
| Radionuclides-gross & activity | | 3pci/L |
| Radionuclides-gross B activity + | | |
| Caliform Bacteria | | Not more-than 10/100ml |
| BOD | | 6 |
| COD | | 10.0 |
| PH | | 6.5-9.2 |
| Total hardness (as CaCo3) | 500 | |
| Total dissolved solids | 1.500 | |

* Highly toxic + Harzadous to health (1pci = $1^{10}$ curie).