QUALITATIVE AND QUANTITATIVE ASSESSMENTS OF RURAL WATER SUPPLY IN SELECTED LOCAL GOVERNMENTS IN BENUE STATE.

BY

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MATRIC. NO. 2005/21658EA

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JANUARY, 2011

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BEING A FINAL YEAR PROJECT REPORT SUBMITTED IN PARTIAL FUFILMENT OF THE REQUIREMENT FOR THE AWARD OF BACHELOR OF ENGINEERING (B.ENG.) DEGREE IN AGRICULTURAL AND BIORESOURCES ENGINEERING, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGER STATE.

JANUARY, 2011

DECLARATION

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 Information derived from personal communications, published and unpublished work were duly referenced in the text.

Olorunsiwa, Taiye Shola

26/01/2011
Date

CERTIFICATION

This is to certify that the project entitled "Qualitative and Quantitative Assessment of Rural Water Supply in Selected Local Governments in Benue State" by Olorunsiwa, Taiye Shola meets the regulations governing the award of the degree of Bachelor of Engineering (B.ENG.) of the Federal University of Technology, Minna, and it is approved for its contribution to scientific knowledge and literary Presentation.

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ABSTRACT

An appraisal of rural water supply sources to ascertain the information about the information quality and quantity of the various water sources in selected local governments in Benue state. Printed questionnaire were employed as well as personal interviews were used as a means of collecting information. Water samples were collected in three different local governments based on their ethnic group i.e Makurdi, Otukpo and Oju. The samples collected was analyzed in the laboratory. The laboratory analysis shows that the physical properties of the water sources such as conductivity and Turbidity. Makurdi well has conductivity of 798μs/cm, and Turbidity of 0.97NTU, Otukpo borehole has conductivity of 536μs/cm, and Turbidity of 1.99NTU, Oju stream also has conductivity of 60μs/cm, and Turbidity of45.4NTU, while Makurdi Rain has conductivity of 10μs/cm,and Turbidity of1.30NTU. Therefore, they all conform to the NSDWQ and WHO standard of 1000μs/cm for conductivity. For Turbidity, all the samples conform to Turbidity of 5NTU except for Oju stream.For chemical properties such as Nitrate and Nitrite, Makurdi well has Nitrate of 0.26mg/l and Nitrite of 0.01mmg/l, Otukpo borehole has nitrate of 7.46mg/l and Nitrite of 0.03mg/l, Oju stream has Nitrate of 5.88mg/l and Nitrite of 0.001mg/l, while Makurdi Rain has Nitrate of 0.00mg/l and Nitrite of 0.00mg/l. Therefore, all the samples conform to both NSDWQ and WHO standard of 50mg/l for Nitrate and 3mg/l and 0.2mg/l for Nitrite respectivily.While for Biological properties such as E-Coli, all the samples has E-Coli value of 0Cfu/100ml which conform to NSDWQ and WHO standard of 0Cfu/100ml.

Sensitization should be made by civil societies and non-governmental organizations with the collaboration of the government in stressing the need to confirm the portability of their drinking water and treating it before use.

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CHAPTER ONE

1.0 INTRODUCTION

Water is essential for a variety of human activities including consumption, sanitation, recreation, the manufacture of industrial goods and the production of food and fiber. In many developing nations, governments often promise a conventional water supply system for both urban and rural dwellers. However, far too many, especially in the rural areas are still without adequate water supply and there is plenty of evidence of outbreak of water borne diseases.

More than 60% of the Nigerian populations live in rural areas but only about 42% have some forms of portable water supply with about 20% having piped water supply. The problem of covering of the rural population with the reasonable time is beset with difficulties because of the existing condition such as scattered nature of villages, inaccessibility and non availability of other services and also the non-availability of adequate water sources.

Rural community are generally small and poor and hence various limit of schemes have to be necessarily simple and comparatively cheaper requiring the minimum skilled supervision and maintenance which brought about the women's role in rural water supply such as provision of water for general household uses. Water collection can sometimes be a very strenuous exercise, especially when the distance from the source is great and the water is not easily accessible. Moreover, the sources are generally ground water leading to special problems like iron, manganese, fluorides, arsenic, salinity, hardness, etc. Ground water contamination could be traced to a variety of activities while contamination sources such as septic systems are found everywhere; others are regional e.g. saline intrusion. Rural water supply thus has its typical problem and requires to be formulated accordingly.

1.1 Background of the Study

There has been many works and researches on the quality and quantity of water supply in Benue State. However, not much evaluation has been done on the sanitation aspect of the water being consumed in the rural area of the state. This project is aimed at assessing this and suggesting ways of improving it if the water sources are not conformed to world's standard.

1.2 Statement of Problem

In Nigeria, it is only a gain saying that water-borne diseases are rampant especially in the northern area of the country. This can be attributed to government's neglects and low level of literacy of rural dwellers. Though the importance of clean and portable water cannot be over emphasized, rural dwellers do not see it this way. This project is aiming at evaluating the peculiar problems and suggesting ways of solving it in future.

1.3 Objectives of the Study

1. To assess the major water supply sources in selected local governments of Benue State in terms of quantity and quality.
2. To assess the rural sanitary measures being undertaken by Benue State rural dwellers

1.4 Justification of the Study

Water is essential for a variety of human activities including consumption, sanitation, recreation, the manufacture of industrial goods and the production of food and fiber. In Nigeria today, many promises are been made to provide conventional water supply system for both urban and rural dwellers. However, far too many, especially in the rural areas are still without adequate water supply and there is plenty of evidence of outbreak of water borne diseases. Therefore, there is the need to analysis the water supply sources in terms of quality and quantity, in other to reduce the spread of water borne diseases in rural areas.

1.5 Scope of the Study

I. Site visitation to the river where four samples were collected at three different local governments.

II. Laboratory test which includes:

a) Physical Examination

b) Chemical Examination

c) Bacteriological Examination

CHAPTER TWO

2.0 LITERATURE REVIEW

Rural water project need accurate unbiased information about quantity, quality and reliability aspects of the local water sources (American Ground Water Trusts 2009). When this is to be appraised, the first criterion to be put in place is its qualitative realm (Odumosu 1995).

Water quality is a term used here to express the suitability of water to sustain various uses or processes. Any particular use will have certain requirements for the physical, chemical or biological characteristics of water, for example, limits or the concentration of toxic substance for drinking water use, or restrictions on temperature and pH ranges for water supporting invertebrate communities (Meybeck, 1996). Consequently, water quality can be defined by a range of variables which limit water use. Although many uses have some common requirements for certain variables, each use will have its own demand and influence on water quality. Quantity and quality demands of different users will not always be activities be compatible and the activities of another, either by demanding water of a quality outside the range required by the other user or by lowering quality during use of the water (Makella 1996). Effort to improve or maintain a certain water quality often compromise between the quantity and quality demands of different user.

There is increasing recognition that natural ecosystems have a legitimate place in the consideration of options for quality management. This is both for their intrinsic value and because they are sensitive indicators of changes or deterioration in overall water quality, providing a useful addition to physical, chemical and other information.

The water quality of drinking water is analyzed based on its nature and extent of its pollution and contamination. The guidelines to the amount and toxicity level of water for drinking is set to this standard that will have no health risk (Malkki 1996). These contaminants on public water systems require a periodical test. The contaminants and in the nature of physical, chemical and bacteriological forms (Meybeck, 1996).

The composition of surface and underground waters is dependent on natural factors (geological, topographical, and meteorological) in the drainage basin and varies with seasonal differences in run off volumes, weather condition and water levels. (Kuusisto, 1996).

2.1 Characteristics of Surface Water

2.1.1 Hydrological Characteristics

Continental water bodies are of various types including flowing water; lakes, reservoirs types. All are inter-connected by the hydrological cycle with many intermediate water bodies, both natural and artificial. Wetlands such as floodplains, marshes, and alluvial aquifers have characteristics that are hydrological intermediate between those rivers, lakes and ground waters. Wetlands and marshes are of special biological importance (Meybeck 1996).

Note: Actual residence, times may vary, Residence times in Karstic aquifers may vary from days to thousands of years, depending on the extent and recharge (Makela 1996). Some Kerstic aquifers of the Arabian Peninsula have water more than 10,000 years old. It is essential that available hydrological data are included in a water quality assessment because water quality is profoundly affected by the hydrology of a water body. The minimum information required is the seasonal variation in river discharge. The thermal and mixing regimes of lakes, and the recharge, the thermal and underground flow patter of ground water (Kuusisto 1996).

2.1.2 Water Residence Time

The theoretical residence time for a lake is the total volume of the lake divided by the total outflow rate.

Residence time is an important concept for water pollution studies because it is associated with the time taken for recovery from a pollution incident. For example, a short residence time (as in a river) aids recovery of the aquatic system from a pollution input by rapid dispersion and transport of water-borne pollutants. Long residence times, such as deep lakes and aquifers, often result in very slow recovery from a pollution input because transport of water borne pollutants away from the source can take years even decades. Pollutants stored in sediments take a long time to be removed from the aquatic system even when the water residence time of the water body is short (Meybeck 1996).

River flow unidirectional, often with good lateral and vertical mixing, but may vary widely with meteorological and climatic conditions and drainage pattern. Still surface waters, such as deep lakes and reservoirs are characterized by alternating periods of stratification and vertical mixing. (Meybeck 1996). In addition, water currents may be multidirectional and are much slower than in rivers. Moreover, wind has an important effect on the movement of the upper layers of lake and reservoir water. The residence time of water in lakes is often more than six months and may be as much as several hundred years. By contrast, residence times in reservoirs are usually less than one year.

2.1.3 Lakes and Reservoirs

An important factor influencing water quality in relatively still deep waters, such as lakes and reservoirs is stratification (Makki 1996). Stratification occurs when the water in lake or reservoir acts as two different bodies with different densities one floating on the other. It is most commonly caused by temperature differences in density (water has maximum density at 4^0C), but occasionally by difference in source concentrations. Water quality in the two bodies of water is also subjected to different influences (Makella). Thus, for example, the surface layer receives more sunlight while the lower layer is physically separated from the atmosphere (which is a source of gasses, such as oxygen) and may be in contact with decomposing sediments which exert an oxygen demand. As a result of these influence, it is common for the lower layer to have significantly decrease concentration compared with the upper layer. When anoxic conditions occur in bottom sediments, various compounds may increase in interstitial waters (through dissolution or reduction) and diffuse from the sediments into the lower water layer. Substances produced in this way include ammonia, nitrate, phosphate, sulphide, silicate, iron and manganese compounds.

2.1.4 Rivers

An understanding of the discharge regime of river is extremely important to the interpretation of water quality measurements especially those including suspended sediments or intended to determine the flux of sediment or contaminants. The discharge of a river is related to the nature of its catchment, particularly the geological and climatologically influences. (Kuusisto 1996).

2.2 Characteristics of Ground Water

Ground is held in the pore space of sediments such as sands, or gravels, or in the fissures of rock such as crystalline rock and limestone. The body of rocks or sediments containing the water is termed and the upper water level in the saturated body is termed the water table. Typically, ground water have a steady flow pattern velocity is government mainly by the porosity and permeability of the mineral through which the water flows, and if often up to several orders of magnitude less than that of surface waters. As a result mixing is poor (Makella 1996).

2.2.1 Aquifer

Aquifers may be confined or unconfined. A confined aquifer is overlain by an impermeable layer that prevent recharge (and contamination) by rainfall or surface water. Recharge of confined aquifers occurs where the permeable rock outcrops as or near the surface, which may be some distance from the area of exploitation. This feature may make control of quality and of pollution more difficult. Some aquifers are not perfectly confined and are termed semi-confined or leaky (Malkki 1996).

Unconfined aquifers are over lain by a permeable, unsaturated zone that allow surface water to percolate down to the water table. Consequently, they are generally recharged over a wide area and are often shallow with a tendency for interaction with surface water.

Confined aquifers are less vulnerable than unconfined aquifers to pollution outside their recharge zone because surface water and contamination cannot percolate to the water table. If contamination does occur, however, it is often difficult to remedy because confined are usually deep and the number of points where contaminated water may be pumped out is limited. Given the limited outflow, contaminants may also be increasingly concentrated in confined aquifers and this may restrict abstraction of water. The greater interaction of confined aquifers, to contamination is a result of the wider area over which they are recharged and in which contamination may enter, and the greater interaction with polluted surface water bodies which may lead to contaminant movement into groundwater. The risk of contamination will depend on the depth of the overlying unsaturated layer, the rate of infiltration to the water table and land use in areas surrounding ground water sources.

2.2.2 Water Quality

The quality of groundwater depends on the composition of the recharge water, the interactions between the water and the soil, soil-gas and rocks with which it comes into contact in the unsaturated zone, and the residence time and reactions that take place within the aquifer. Therefore, considerable variation can be found, even in the same general area, especially where rocks of different compositions and solubility occur. The principal processes influencing water quality in aquifers are physical (dispersion/dilution, filtration and gas movement), geochemical (complexation, acid-base reaction, oxidation – precipitation – precipitation – solution, and absorption-desorption) and biochemical (microbial respiration and decay cell synthesis).

Ground water quality is influenced by the effect of human activities, which cause pollution at the land surface, because most ground water originates by recharge of rainwater infiltration from the surface. The rainwater itself may also have an increased acidity due to human activity. The unsaturated zone can help reduce the concentrations of water pollutants entering ground water (especially micro-organisms), but it can also act as a store for significant quantity of pollutant such as nitrates, which may eventually be released. Some contaminants enter ground water directly from abandoned wells, mines, quarries and buried sewerage pipes which by-pass the unsaturated zone (and therefore, the possibility of some natural decontamination processes).

2.2.3 Contaminants

Artificial pollution of groundwater may arise from either point or diffuse sources. Some of the more common sources includes domestic sewages and latrines, municipal solid waste, Agricultural waste, manure and industrial wastes (including tipping direct injection, spillage and leakage). The contamination of ground water can be a complex process (Meybeck 1996).

Contamination such as Agriculture, Chemical spread over large sections of the aquifers recharge area may take decades to appear in the groundwater and perhaps longer to disappear after their use has ceased (America groundwater trust 2009). Major accidental spills and other point sources of pollutants may initially cause rapid local contamination, which then spreads through the aquifer. Pollutants that are fully soluble in water and of about the same density (such as chloride-contaminated water from sewage) will spread through the aquifer at a rate related to the groundwater flow velocity. Pollution that is less dense than water will tend to accumulate at the water table and flow along the surface. Dense compound such as chlorinated solution will move vertically downward and accumulate at the bottom of an aquifer.

There is usually a delay between a pollution incident and detection of the contamination at the point of water abstraction because movement in the unsaturated zone and in the aquifer is often slow. For similar reasons, the time needed to "flush out" a pollutant is long and in some cases the degradation of ground water may be considered irreversible.

Land use areas surrounding boreholes and where aquifers are recharged should be carefully monitored as part of a pollution control programmed. The vulnerability of the aquifer to pollution will depend, in part, on the human activity and land use in areas where rainfall or surface water may percolate into the aquifer is likely to cause groundwater pollution.

2.3 Natural Processes Affecting Water Quality

Although degradation of water quality is almost invariably the result of human activity, certain natural phenomena can result in water quality falling below that required for particular purposes (EPA 2008). Natural events such as torrential rainfall and hurricanes leads to excessive erosion and landslides, which in turn increased the content of suspended material in affected rivers and lakes. Seasonal overturn of the water in some lakes can bring water with little or no dissolved oxygen to the surface. Such natural events may be frequent or occasional. Permanent natural conditions in some areas may make water unfit for drinking or for specific uses such as irrigation (EPA, 2008). Common examples of these are salinization of surface water through evaporation in arid and semi-arid regions and the high salt content of some ground waters under certain geological conditions. Many ground waters are naturally in carbonates (hardness), thus necessitating their treatment before use for certain industrial applications, groundwater in some regions contain specific ions (such as fluoride) and toxic elements (such as arsenic and selenium) in elements that causes other types of problem (such as the staining of sanitary fixtures by iron and manganese).

The nature and concentration of chemical elements and compounds in a freshwater system are subject to change by various types of natural process, i.e. physical, chemical, hydrological and biological. The most important of these process and the water bodies they affect are listed in table 2.1

The effects on water quality of the processes listed in table 2.1 will depend to a large extent on environmental factors brought about by climatic, geographical and geological conditions. The major environmental factors are:

- Distance from the ocean: extent, of sea spray rich in Na^+, Cl^-, Mg^{2+}, SO^{4-} and other ions.
- Climate and vegetation: regulation of erosion and mineral weathering, concentration of dissolved material through evaporation and evapotranspiration.
- Rock composition (lithology): the susceptibility of rocks to weathering ranges from 1 for granite to 12 for limestone, it is much greater for more highly soluble rocks (for example, 80 for rock salt).

- Terrestrial vegetation: the production of terrestrial plants and the way in which plant tissue is decomposed in soil affect the amount of organic carbon and nitrogenous compounds found in water.
- Aquatic vegetation: growth, death and decomposition of aquatic plants and algae will affect the concentration of nitrogenous and phosphorus nutrients, pH, carbonates, dissolved oxygen and other chemicals, vegetation has a profound effect on the chemistry of lake water are less pronounced, but possibly significant effects on river water.

Table 2.1 Important Processes Affecting Water Quality

Process Type	Major processes affecting water body	Water Body
Hydrological	Dilution	All water bodies
	Evaporation	surface waters
	Percolation and leading	Ground waters
	Suspension and settling	Surface waters
	Gas exchange and atmosphere	Mostly rivers and lakes
	Volatilization	
	Adsorption/desorption	
	Heating and cooling	All water bodies
	Diffusion	Mostly river and lakes
Chemical	Photo degradation	All water bodies
	Acid base reactions	All water bodies
	Redox reactions	All water bodies
	Dissolution of particles	All water bodies
	Precipitation of minerals	All water bodies
	Ionic exchange	Ground waters
Biological	Primary production	Surface waters
	Microbial die-off and growth	All water bodies
	Decomposition of organic matter	Mostly rivers and lakes
	Bioaccumulation	Mostly rivers and lakes
	Biomagnefication	Mostly rivers and lakes

Source: EPA, 2008

Under the influence of these major environmental factors, the concentrations of many chemicals in river water are liable to change from season to season. In small water sheds, (<100km^2), the influence of a single factor can cause a variation of several orders of magnitude. Water quality is generally more constant in watersheds greater than 100,000km^2 and the variation is usually within one order of magnitude for most of the measured variables.

Within any one water body, water quality can differ with time and place. Differences due to time are of five types: minute-to-minute and day-to-day, differences resulting from water mixing and fluctuations in inputs usually as a result of meteorological conditions. These differences are most evident in small water bodies. Diurnal (24-hour) variations resulting from biological cycles and day/darkness cycles which cause changes in, for example dissolve oxygen and pH, Diurnal patterns also result from the cyclic nature of waste discharges from domestic and industrial sources.

- **Irregular Patterns:** Irregular sources of pollution include fertilizers, pesticides and herbicides, present in run-off from Agricultural land, and wastes discharged from food processing plants. The resultant variations in water quality may be apparent over a matter of days and months.
- Seasonal biological and hydrological cycles
- Year-to-year trends, usually of increased human activities in the water shed.

Water quality differences may result either internal or external processes. Internal processes usually cyclic with either daily or seasonal reoccurrence, and are not directly related to the size of the water body. External processes, such as the addition of pollutants may be buffered by large water bodies (depending on the flow regimes) and long water residence times (Meybeck 1996).

As a result, the average composition of a large lake probably changes little from one year to the next. Similarly, the differences in water quality at different times fo the year will be much greater for a large river. This means that the sampling frequency necessary to allow average water quality to be described correctly is normally much greater for a stream than for a river, for lakes, it is normally much lower than for rivers (United Nations Environmental programme (U. N. E. P.) and WHO in 1996).

Water quality differences from place to place depend more on the homogeneity of the water body than size. The water is a round lake, for example, may be adequately described by one sample taken from near the centre of the lake. Long, thin lake, with many bays and inlets will require more samples, the minimum is 3 while the optimum number could be 10 or more. In lakes, up to 5 samples can be taken at depths determined by a condition measured in the field.

The flow pattern, or regime of any particular river will be the product of very specific conditions. Although similar to that of rivers in the surrounding geographical region, it will be extensively influenced by attitudes, exposure of the slope to wind and variations in rainfall.

2.4 Water Quality Standard

The effects of human activities on water quality are both widespread and varied in the degree to which they disrupt the ecosystem and or restrict water use. Pollution of water by human faeces, for example is attributable to only one source, but the treasons for this type of pollution, its impacts on water quality and necessary remedial or preventive measures are varied. The effects of industrial effluents in public water contribute lot of alteration on the quality of domestic water system. Some of the discharge comes from the fixtures of distributing and storage systems. The galvanized metals may dope the water that passed through them. The main causes of the contamination also may come from the improver waste disposal (U. S. E. P. A., 2008). Since there is a wide range of natural water qualities, there is no universal standard against which set of analysis can be compared. But a careful study and research recommends the recent findings of the United State Environmental Protection Agency (E. P. A.) for its wideness and range of consideration (E. P. A. 2008). The standard for drinking water has established National Primary Drinking Water Regulations that set a mandatory water quality standard called "Maximum contaminants levels" or "MCLs" which was established to protect the public against consumption of drinking water contaminants that present a risk to human health (E. P. A. 2008). An MCL is the maximum allowable amount of contaminants in drinking water which is delivered to the consumer.

Inclusive also is the secondary drinking water regulation that set non-mandatory water quality standard for its contaminants. Though not enforced but a guideline to assist public water systems in managing their drinking water for aesthetic consideration, such as taste, colour and odour. The contaminants are not considered to present a risk to human health at the secondary maximum contaminants levels (SMCLs). (E. P. A. 2008).

2.4.1 Microbiological Contaminants

The present of microbiological contaminants are a health concern at certain levels of exposures. If water is inadequately treated, microbiological contaminants in that water may cause disease (E. P. A. 2008). Diseases symptoms may include diarrhea, crumps, nausea and possibly jaundice and any associated headaches and fatigue. These symptoms however are not just associated with set standards enforceable requirements for treating drinking water to reduce the risk of these adverse health effects.

Treatments such as filtering and disinfecting the water remove or destroy microbiological contaminants. Drinking water which is treated to meet the requirements is associated with little or none of these risks and should be considered safe.

2.4.2 Inorganic Contaminants

There are many source of inorganic contaminants some of it is man-made and others occur naturally. These chemicals may get into drinking water, through natural weathering of rock, industrial from mining operations, seep from fertilizer, human animal sewage, corrosion of galvanized pipe and general improper waste disposal (EPA 2008).

2.4.3 Disinfection By-Products

A wide variety of chemicals are added to drinking water to remove various contaminants. Among them are alum, iron salt, chlorine and other oxidizing agents, all of which may leave residues or potentially hazardous by-products in the finished water. In fact, the most common source of synthetic organic chemicals in treated drinking water is the interaction of chlorine or other disinfectants with the naturally occurring particles found in water. (EPA 2008).

Acrylamide and Epichlorohydren

Polymers made from epichlorohydren and acrylamide are sometimes used in the treatment of water supply as a flocculent to remove particles. Epichlorohydren and acrylamide generally gets into drinking water by improper use of these polymers. This chemical has been shown to cause, cancer in laboratory animals such as rats and mice when they are exposed to high levels over time (EPA 2008). Chemical that causes cancer in laboratory animals may also increase the risk of cancer in human who are exposed over long period of time. This treatment techniques limits the amount of the polymer which may be used in drinking water as a flocculent to remove particulates. Drinking water system which comply with this treatment technique have little or no risk and are considered safe with respect to epichlorohydien and acryl amide (EPA, 2008).

2.5 Water and Human Health

Water, although an absolute necessity for life ca be a carrier of many diseases paradoxically, the ready availability of water makes to present the hygiene measures that are essential to prevent the transmission of enteric diseases. Infections water-related diseases can be categorized as water borne, water hygiene, water-contact and water habitat vector diseases. Some water related diseases however may fall into more than a category (WHO 1996).

Water-borne infections diseases are those in which the pathogen, or causative organism, is present in water and ingested when the water is consumed. Most of the pathogens involved are derived from human faeces and the diseases transmitted through media other than water for example, faecally contaminated foods, fingers or utensils. The principal faecal-oral disease are cholera, typhoid, shigellosis, amoebic dysentery, hepatitis A and various types of diarrhea (WHO 1996).

One disease that is exclusive water borne is dracunculiasis or guinea worm diseases, which is caused by dracunculus medinensis. An individual can become infected with Uracunculus only by consuming water contaminated with the microscopic crustaceans (Cyclops) that contain the larvae of the pathogen. Dracunculiasis is not a faecal oral disease.

The incidence, prevalence and severity of water hygiene diseases can be reduced by the observance of high level of personal, domestic and community hygiene. Almost all water borne diseases excluding dracunculiasis are water hygiene diseases. Water hygiene diseases include tinea, scabies, pediculosis, skin and eye diseases. Tinea, a skin disease, trachoma, an eye disease, and insect infestations such as scabies and pediculosis (lice) occur less frequently when personal hygiene and cleanliness are of high standard. Water must be available in adequate quantities to permit hand washing, bathing, laundering, house cleaning and cleaning of cooking and eating utensils. The quantity require for these purpose is substantially greater than that needed for drinking (EPA, 2008).

CHAPTER THREE

3.0 MATERIAL AND METHODOLOGY

3.1 Description of the Study Site

The study area is Benue state, north central Nigeria.

What is today Benue State was created on February 3, 1976. The state derives its name from river Benue, the second longest river in the country and the most prominent geographical feature in the state.

At its inception, the state comprised of only 7 local governments namely' Gboko, Katsina-Ala, Makurdi, Ankpa, Dekina, Idah and Otukpo. Several government creation exercises increased these, first to 13 and later 19. With the creation of more states and local government in 1991, the Igala-speaking local government was exercised to form the present Kogi State. The new Benue state has twenty-three (23) local governments, fourteen (14) in the Tiv-speaking area, and seven (7) in the Idoma-speaking area and two (2) in the Igede-speaking area.

Location

Benue state lies in the middle of the country and shares boundaries with five other states namely: Nassarawa to the north, Taraba to the east, Cross River to the South, Enugu to the South-west and Kogi to the east. The state also shares a common boundary with Republic of Cameroon on the south-east. Benue state has population of 2,780,389 (1991 census) and 3, 807, 932 (2005) and occupies a landmass of 30,955 square kilometer.

Climate

Benue State experiences a typical climate with two distinct seasons, the wet/rainy season and the dry season. The rainy season lasts from April to October with annual rainfall in the range of 150 – 180mm. The dry season begins in November and ends in March. The temperature fluctuate between 23 and 30 degrees centigrade in the year. The south-eastern part of the state adjoining the Obudu-Cameroon mountain range, however, has a cool climate similar to that of Jos Plateau.

3.2 Sample Analysis

The various predominant water supply sources is assed and various are collected for a laboratory analysis. The water is analysed to b compared with the international Drinking Water Standard of WHO/NAFDAC and UNEPA.

The analysis involves the national Primary Drinking Water Regulation that set a mandatory water quality standard called" Maximum Contaminant Levels" or "MCLs". This is categorized to physical analysis of pH, turbidity, temperature, etc. and Microbiological Contaminant Analysis of Total Coliforms and Feacal Coil or Esherichia Coil (E. Coil). Additionally, that of its inorganic contaminant test (chemical).

MAP OF BENUE STATE SHOWING ITS LOCAL GOVERNMENT AREAS

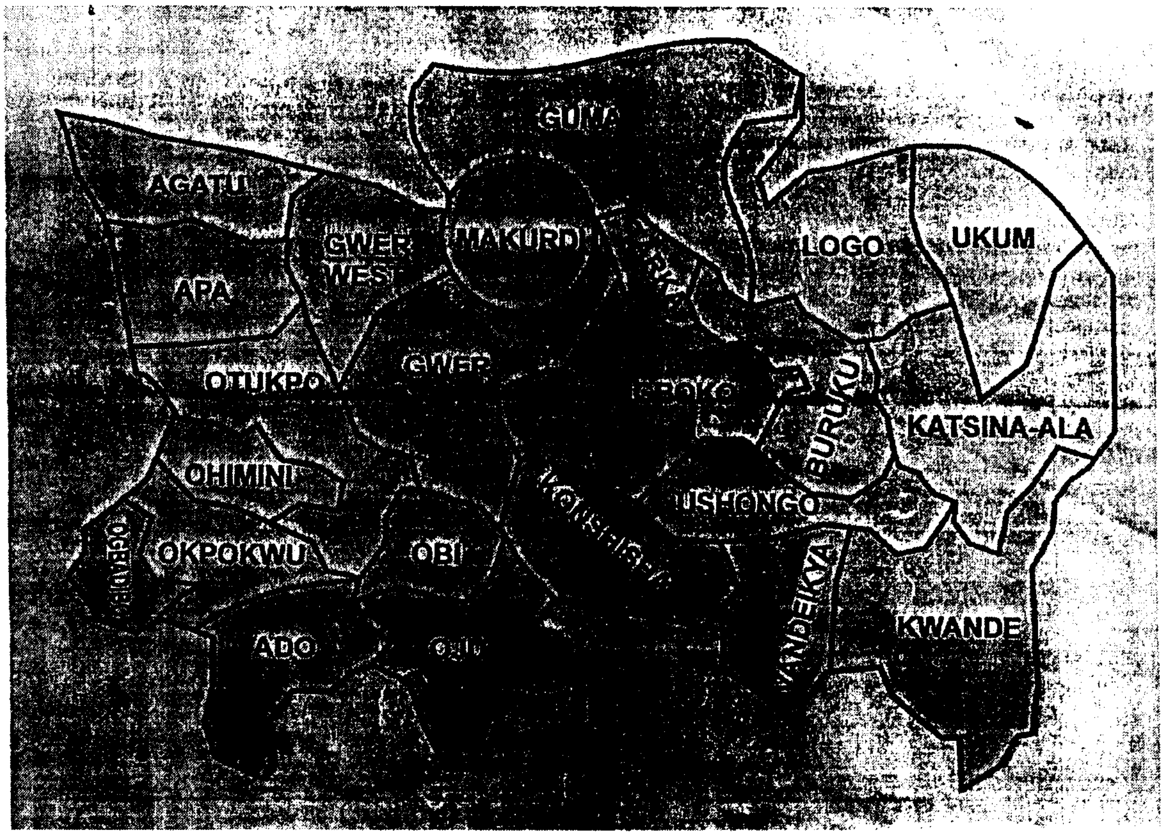

Fig. 3.1 map of Benue state

Source: Benue state dairy, 2007

3.3 About the Questionnaire

From the appendix, the questionnaire consists of twenty (20) questions which include the various methods of water sources, its quality and quantity, their mode of purification, distance of water source to their homes, time involved in a trip and type of containers used in getting water from its source to their homes.

The questionnaire was a closed ended questionnaire in such a way that most questionnaires filled were done by me because most of the people investigated were illiterates and semi illiterates, pictures were taken and personal interviews were also conducted

CHAPTER FOUR

4.0 DISCUSSION OF RESULT

4.1 Analysis of Questionnaire

4.1.1 Water Sources used in Rural Area of Benue State

Figure 4.1.1 shows the result of various investigations made on the major water supply sources in some villages in Benue state. The various sources were observed. It shows that wells and borehole are mostly used, due to its proximity and quality, this makes bucket to be predominantly used in its fetching. The quantity of the source is the prime factor in their water sources with little or no attention to the water quality, purification and sanitation.

For sufficiency and sustainability of rural water supply, more boreholes should be sunk since it meets the drinking water quality standard. The wells and streams should be tested first before subsequent use. Household hygiene of apron and one fetcher should be encouraged with water purification when necessary.

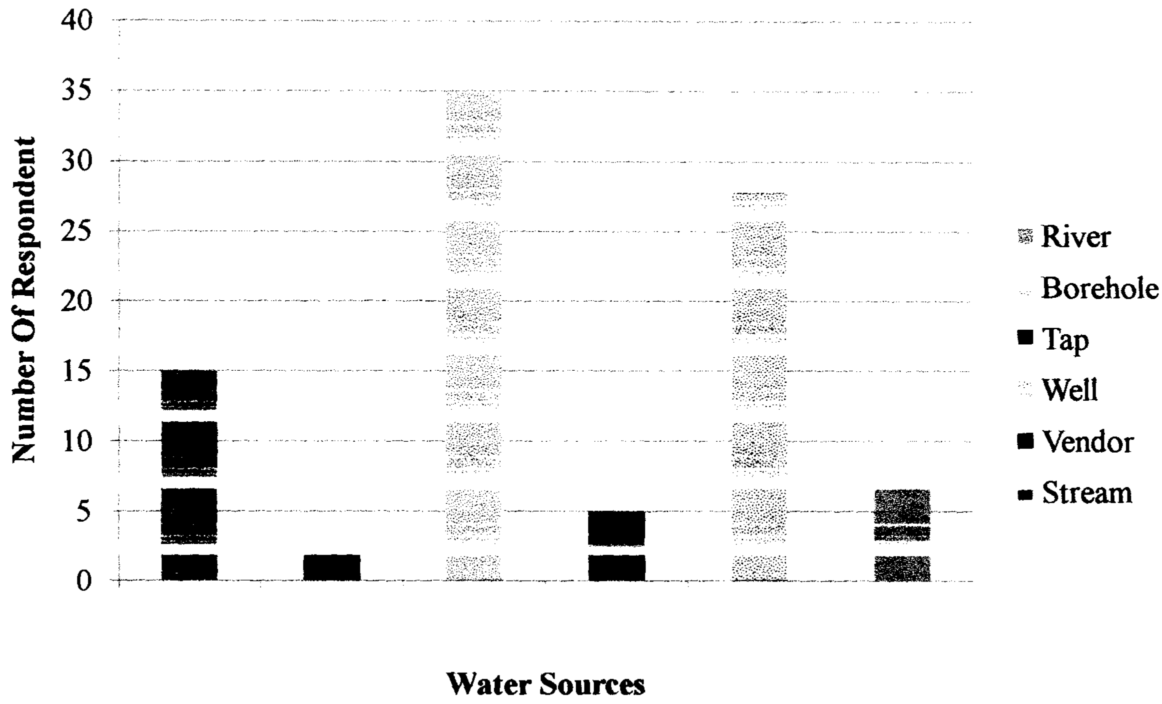

fig. 4.1.1: Water Sources in Rural Area of Benue State.

4.1.2 Reasons for Choosing the Water Sources

Figure 4.1.2 shows the reasons for choosing the water supply sources by the rural dwellers of Benue state. The chart shows that most people's choice is based on proximity and quality, their perception of quality water is based on colour, odour and taste which are not good criteria for testing safe water.

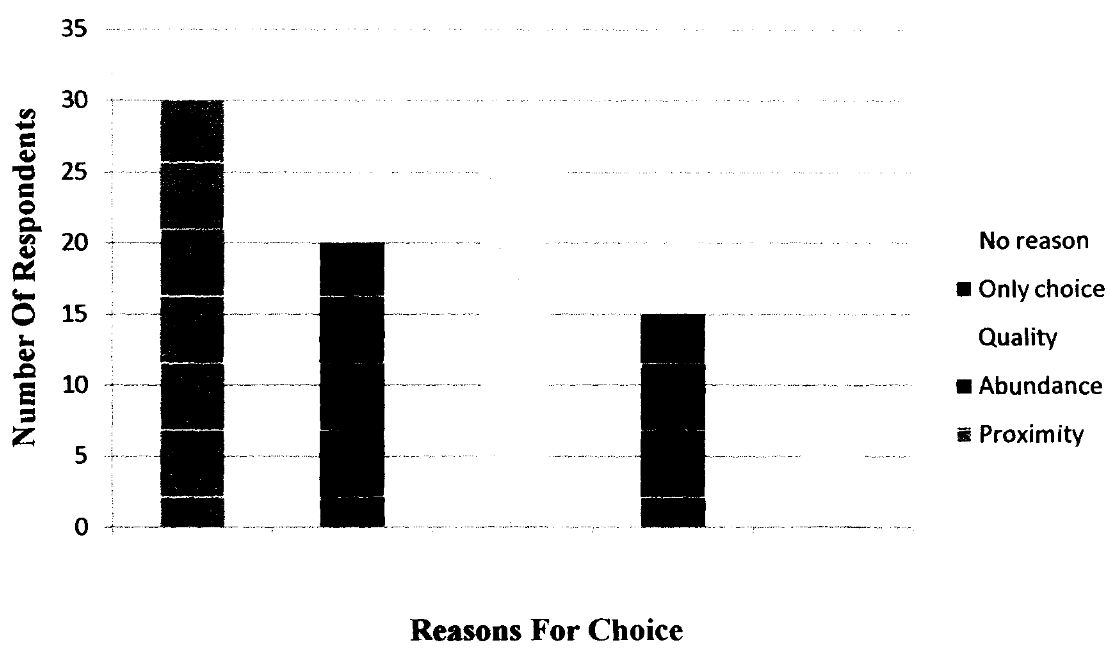

fig. 4.1.2: Reasons for Choice of Water Source

4.1.3 People mostly involved in Fetching Water

Figure 4.1.3 shows the category of people involved in fetching water in rural area of Benue state. The chart indicates that mostly young female and adult female are involved the fetching of water in rural area of Benue state. This is not due to the culture of the people but for the source and proximity. Children are not allowed to go near wells except for borehole in some cases for risk of accident.

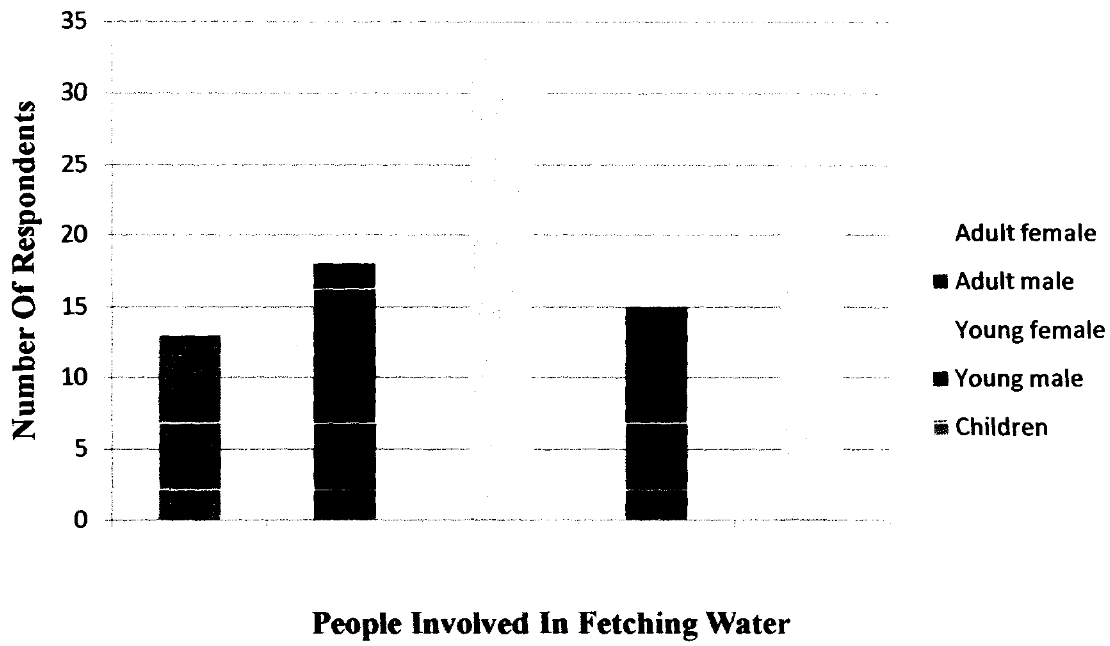

Fig. 4.1.3: Category of People Involve in Fetching Water

4.1.4 Mode of Purification of Water

Figure 4.1.4 shows the various methods of purification used by the rural dwellers of Benue state. The chart shows that most people don't treat their water before use. This is so because their primitive idea that dirty or contaminated water does not kill, and illness attached to contaminated water. Addition of alum is only done to water during dry season, when supply of water is running short. Though alum only treats water by coagulating suspended solids and not kills the microorganisms present in the water. Boiling of the water will have been more effective in killing the microorganisms present in the water but is not been carried out, thus, the people should be properly sensitize on how to properly purify their water before drinking.

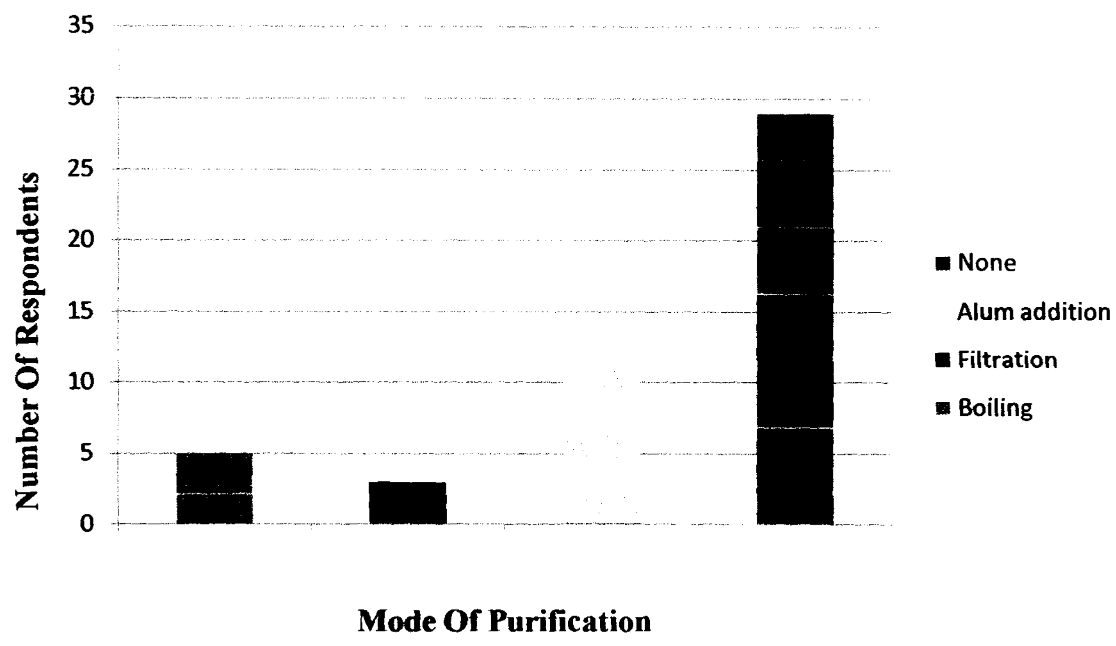

Fig. 4.1.4: Mode of Purification

4.1.5 Types of Container used in Fetching Water

Figure 4.1.5 shows the various type of container used in fetching water by the rural dwellers of Benue state. The chart shows that buckets are mostly used and most buckets do not have cover thereby exposing the water to various form of microorganisms. It is therefore advised that jerry-can and buckets with cover be use to reduce the risk of contamination and they should be properly washed before use.

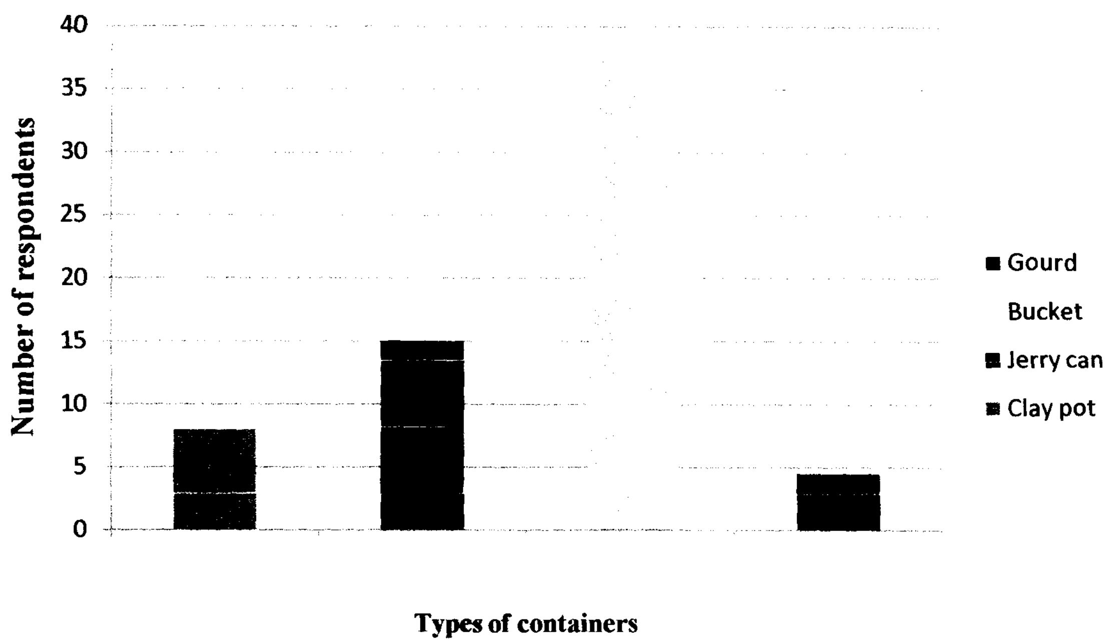

Fig. 4.1.5: Containers Used Water fetching

4.2 Water Sample Analysis Result

4.2.1: Conductivity

Conductivity is the case to which a substance allows free flow of electricity through its ions. WHO and the Nigerian Standard for Drinking Water Quality have set a maximum permissible level of the conductivity to be 1000µs/cm. Any level above this can cause total brain damage with time and can also cause defective endocrine functions. Table 4.1 shows that all water samples are within the maximum permissible level.

4.2.2: Turbidity

It's the physical parameters in which a water parameter is detected by the presence of colloidal particles when the sample is agitated; it's measured in (NTU). The maximum detection of such a parameter for WHO standard and the Nigerian Standard for Drinking Water Quality is

5. Any level above this is risky to human health. Table 4.1 shows that out of the four (4) samples analyzed, only one (1) is not safe as far turbidity is concern. Hence treatment of the water should be done before consumption.

4.2.3: Nitrate and Nitrite

The Nitrate and Nitrite is the Nitrogenous compound that when it's in excess in our drinking water can cause reduction of oxygen capacity of the blood, shortness of breath and blueness of skin. WHO and Nigerian Standard for Drinking Water Quality have set 50mg/l for Nitrate and 3mg/l and 0.2mg/l for Nitrite as the maximum respectively. Table 4.1 shows that all the samples are safe as far as Nitrate and Nitrite is con concern.

4.2.4: Coliform

The measurement of Coliform is used in getting the bacterial count in the water sample. WHO standard and the Nigerian Standard for Drinking Water Quality set 0 as the maximum for Coliform and is measured in cfu/100ml. therefore the detection of any bacteria count will render the water not suitable for consumption and therefore be treated before use. Table 4.1 shows that all water samples are not safe as far Coliform is concern.

4.2.5: Total Dissolved solid

This is the number of dissolved solid present in water. WHO standard and the Nigerian Standard for Drinking Water Quality have set 1000mg/l and 500mg/l respectively as the maximum tolerance for total dissolved solid, any level higher than this is dangerous to human health. Table 4.1 shows that all the four (4) are safe as far WHO standard but for Nigerian Standard for Drinking Water Quality only three (3) is safe.

Table 4.1: Water Sample Analysis Result.

s/n	Parameters	Units	W1	W2	W3	W4	WHO	NSDWQ
1	Conductivity	µs/cm	798	536	6	10	1000	1000
2	Temperature	°c	26.25	26.2	26.8	26.7	N.S*	Ambient
3	PH		5.16	6.67	5.19	5.66	6.5-8.5	6.5-8.5
4	Turbidity	NTU	0.97	1.99	45.4	1.3	5	5
5	TDS	mg/l	534.66	339.12	40.2	6.7	1000	500
6	DO2	mg/l	17.33	15.57	14.35	12.91	7.5	N.S*
7	Chloride	mg/l	140.45	18.99	74.47	47.46	250	250
8	Total Hardness	mg/l	157.14	105.09	19.02	11.01	250	150
9	Alkalinity	mg/l	18	52	11	3	N.S*	N.S*
10	Calcium Hardness	mg/l	93.08	64.05	8.01	3.01	N.S*	N.S*
11	Nitrate	mg/l	0.26	7.48	5.88	0	50	50
12	Calcium2+	mg/l	37.31	25.67	3.21	1.2	N.S*	N.S*
13	Magnesium2+	mg/l	15.63	10.01	2.68	1.95	N.S*	N.S*
14	Sulphate	mg/l	13	18	30	0	250	200
15	Mg Hardness	mg/l	64.06	41.04	11.01	8	N.S*	N.S*
16	Nitrite	mg/l	0.01	0.03	0.001	0	3	0.2
17	Sodium	mg/l	46	29	1.5	0	200	200
18	Flouride	mg/l	0	0.18	0	0	1.5	1.5
19	Potassium	mg/l	8.71	0.67	0.67	0	N.S*	N.S*
20	Ammonia	mg/l	0.06	1.69	1.33	0	N.S*	N.S*

21	Bicarbonate	mg/l	18	52	11	3	N.S*	N.S*
22	Carbonate	mg/l	0	0	0	0	N.S*	N.S*
23	Coliform	cfu/100ml	17	43	28	2	0	0
24	E-coli	cfu/100ml	0	0	0	0	0	0

4.3: Personal Assessment

From the assessment, it was observed that most of their sources are not hygienic enough. For instance, swimming in the same stream use for domestic consumption. (Plate 4.1), improperly covered well (plate 4.4). Fetching with metal fetcher (plate 4.5) which with time begins to rust and the iron content can cause cancer.

Plate 4.2 shows a borehole with its own funnel and plate 4.3 shows a properly covered well with apron and its own fetcher.

Plate 4.1: Boy swimming in a stream
In Oju L.G.A

plate 4.2: A borehole with it's own funnel
In Otukpo L.G.A

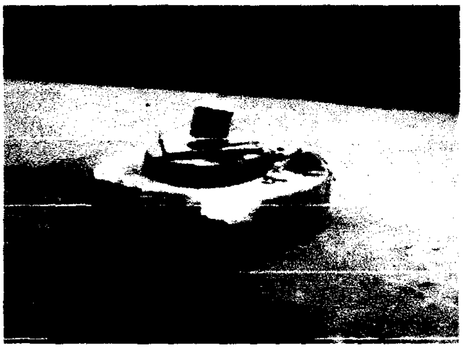

Plate 4.3: A properly covered well
In Makurdi L.G.A

plate 4.4: Improperly covered well
In Oju L.G.A

Plate 4.5: A boy fetching with metal fetcher
In Makurdi L.G.A

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusions

The rate of illiteracy in our rural areas is something that has to be dealt with in terms of purification of water before consumption because from the charts drawn, most people do not engage in any form of water purification, most people use bucket, and the distance from their homes is not encouraging. The people's main concern is the quantity of water that will be enough for their use. The quality of their water is based on their perception of colour, odour and taste which is not the only criteria for testing safe water.

5.2 Recommendations

It is observed that despite the effect of the people in getting dug wells for themselves and government providing boreholes is still not enough to carter for the need of the people due to the shortage of water experienced during the dry season. Therefore, government with the collaboration of civil society groups and non-governmental organizations (NGO's) should provide more boreholes and accessible portable drinking water to rural dwellers.

It was also observed that most wells do not have apron that will prevent erosion or water runoff from getting into the well and that people do come with their own fetcher which is not hygienic or proper. Therefore, it is recommended that an apron should be built and a cover should be made for the well, there should also be a provision for one fetcher which everybody will use and someone should be assigned to wash the fetcher at end of each day, in that way, some water borne diseases would be prevented and also the distance to the source of water should be made closer to the villagers by providing more sources of water for the rural dwellers and also government should provide central purification board to assist in purifying the water. It is also recommended that Jerry-can be used instead of the open container used to help prevent tiny particles and iron bucket should not be used because of its ability to react with water after a long time.

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APPENDIX

QUESTIONNAIRE ON QUALITATIVE AND QUANTITATIVE APPRAISAL OF WATER SUPPLY SOME SELECTED LOCAL GOVERNMENT IN BENUE STATE.

Dear Respondent,

This questionnaire is basically for research purpose, whatever answer(s) supplied herein will be treated confidentially.

1. Name of the village ……………………………………………………..
2. Local government area ………………………………………………….
3. Population:

   ☐ 1000-5000 ☐ 5000-10000 ☐ 10000-20000 ☐ 20000 -Above

4. Respondent's occupation:

   ☐ Farming ☐ Trading ☐ Paid Employment ☐ House wives ☐ Artisan

5. What are the major water supply sources in your community?

   ☐ Stream ☐ Well ☐ Borehole ☐ River ☐ Tap ☐ Vendor ☐ Pond

6. If well, what is the mode of delivery?

   ☐ Manual ☐ Hand pump ☐ Electric pump

7. What considerations were made before choosing the source(s) ticked above?

☐ Proximity ☐ Quality ☐ Abundance ☐ Only choice ☐ No reason

8. What are the sources of finance for the water projects?

☐ Government ☐ Individual ☐ NGO ☐ Philanthropist ☐ Community effort

9. What group of people is mostly involved in water fetching?

☐ Adult men ☐ Young men ☐ Adult women ☐ Young women ☐ Children

10. Has there been an epidemic of a water-borne disease in your community?

☐ Yes ☐ No

11. If yes, what type of disease?

☐ Cholera ☐ Typhoid ☐ Dysentery ☐ Diarrhea ☐ Others (specify)

12. What mode of purification do you employ before using your water?

☐ Boiling ☐ Filtration ☐ Alum addition ☐ None

13. What is the distance to the water source?

☐ <100m ☐ 100m-500m ☐ 500m-1km ☐ >1km

14. What type of container do you use?

☐ Clay pot ☐ Jerry-can ☐ Bucket ☐ Drum ☐ Gourd

15. If the water project is being financed by community effort, what is the method of raising money?

☐ Taxation ☐ Contribution ☐ Others (specify)

16. What are the problems encountered in the execution of water projects?

☐ Financial ☐ Coordination ☐ Deep water table ☐ Purification

17. How are the problems identified in 16 above overcome?

☐ Government aid ☐ Donor agency ☐ Others (specify)

18. Where do you place the water while coming from the water source?

☐ Head ☐ Shoulder ☐ Motor cycle ☐ Bicycle ☐ Vehicle

19. What is the average time employed in the fetching trip? (Mins.)

☐	☐	☐	☐	☐	☐	☐	☐
5	10	15	20	30	45	6	above 60

20. What is the per capital consumption (liters)

☐	☐	☐	☐
<1	10-50	50-100	>100

....

OLORUNSIWA TAIYE SHOLA

Analysis of questionnaire

Local Government	Name of Village	Range of Population	Water Source	Mode of Purification	Type of Container Used
Makurdi	Logo 1	1000-6000	Well, Rain	None	Bucket and Jerry-can
Otukpo	Adoka	1000-5000	Borehole	None	Bucket and Jerry-can
Oju	Ikachi	1000-5000	Stream	Addition of Alum	Bucket, Jerry-can and Clay pot

LEGEND:

N.S*: Not Specified

NSDWQ: Nigeria Standard for Drinking Water Quality.

W_1: Makurdi Well

W_2: Otukpo Borehole

W_3: Oju Stream

W_4: Makurdi Rain Water