

AN APPRAISAL OF PORTABLE WATER

SUPPLY SYSTEM IN KEFFI TOWN

KEFFI LOCAL GOVERNMENT AREA

NASARAWA STATE.

BY

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PGD/GEO/99/2000/066

FEBRUARY, 2001

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SUBMITTED BY

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TO

**THE DEPARTMENT OF GEOGRAPHY
SCHOOL OF SCIENCE AND SCIENCE EDUCATION
FEDERAL UNIVERSITY OF TECHNOLOGY MINNA**

**IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE AWARD OF POST GRADUATE DIPLOMA IN
ENVIRONMENTAL MANAGEMENT OF THE FEDERAL
UNIVERSITY OF TECHNOLOGY MINNA
NIGER STATE**

FEBRUARY, 2001

DECLARATION

I hereby declare that this Research project has been prepared by me, under the guidance of Dr UMOH T. UMOH and Dr. P.S. Akinyeye of the department of Geography Federal University of Technology Minna, and it has not been presented in any previous application for higher degree. All sources of information are specially acknowledged by means of references.

ADAMU ABDUULAH
FEBRUARY, 2001.

CERTIFICATION

This is to certify that ,this Research Project entitled AN APPRAISAL OF PORTABLE WATER SUPPLY PROJECT IN KEFFI TOWN, has been carried out by ADAMU ABDULLAHI PGD/ GEO/99/2000/066 and in accordance with the regulations governing the preparation and presentation of project, to meet the requirements for the Award of Post Graduate Diploma certificate in ENVIRONMENTAL MANAGEMENT, of the Federal University of Technology Minna; and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This work is dedicated to
HAJIYA MAMA – ATU

For her foresight in sending me to school and giving
me moral and financial assistance

ACKNOWLEDGEMENT

It is a common saying that behind every successful completion work are men who appreciate hard work .

I want to express my profound gratitude to all the people who made this project possible such as my supervisors Dr. U.T UMOH and Dr. P.S AKINYEYE, Program coordinator who happen to be the Head of Department Dr M.T Usman, Professor M.J Baba, Professor D.O Adefalalu, Dr A.S Abubakar, Dr G.N Nsofor, Dr S. Hallilu, Dr (Mrs) A.E Odafen, DR (Mrs) A.A Okhimamhe all of Department of Geography Federal University of Technology Minna, for all their valuable contributions and necessary corrections.

I owe special debts of Thanks to my friends, especially Abdulkarim Mohammed and Shehu Musa Dogara, the Management of Federal Polytechnic Nasarawa, Alhaji Tanimu Isa Adogo and all my course mates for their contributions and supports.

To cap it all, my unreserved appreciation goes to my family, the entire staff of Keffi water works and other House-holds in community for their response to my questionnaires.

May Almighty Allah bless every one's efforts accordingly and continue to shower His blessings on us, Amin.

ADAMU ABDULLAHI
FEBRUARY 2001.

ABSTRACT

Water is an essential aspect of Human life and it has been accorded priority by the government of the country. Water supply system in keffi town seems not to have been given a proper management attention by the state government.

For the sake of the achievement of these objectives alongside with the cherished policy of water supply system in keffi town, this report is made up of five chapters after the tittle, dedication and acknowledgement, with the subsequent contents pages.

CHAPTER ONE Highlighted on the relevance of the study. That is, the background of the study under which the nature of the research problems are spelt out. It also embodies the aim and how to achieve this aim through its objectives of the research, scope and limitation, the significance of the study and the biography of the study area..

CHAPTER TWO Contains a review of relevant conceptual issues of water supply systems. This include the Sources, Quality, water conservation, Treatment techniques, Distribution system, Uses, Importance, Management of water Resources and Impacts on water Environment.

CHAPTER THREE Research Methodology.

CHAPTER FOUR Highlighted us on the present existing situation in the study area that is the real situation on the site, and the Data Analysis and finally, the Summary of findings.

CHAPTER FIVE treats the appropriate recommendations and conclusions based on the summary of findings, recommendations and suggestion put forward by some members of the public and staff of the water board. The recommendations are appropriate to be for the immediate take-off and future benefit to the community

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CHAPTER ONE

INTRODUCTION

1.0 BACKGROUND OF THE STUDY

"EVERY THING ORIGINATED IN WATER; EVERY THING IS SUSTAINED BY WATER" – J.W.von Goethe.

The role of water as an important element of the natural environment cannot be over emphasized. Water can no longer be taken for granted or considered as free because it is becoming increasingly scarce owing to increasing demand and pollution. It has been shown that Nigeria as a whole is well endowed with water resources, both surface and underground. Water supply system in keffi town seems not to have been given a proper management attention by the state government, (by then Plateau state).

It is the realization of the above, that this research work examined both the past and the present policies as well as the problems facing the water supply scheme, like poor funding, irregular water supply, inadequate power supply to the plant and the conditions of the facilities used.

The need embarking on this research was important because it provide an opportunity of water supply system as well as providing data for other researchers.

The supply of water for keffi from old water work at Old Army Barrack mile five along keffi-Akwanga road which has the capacity of 2784m³/d, while the reservoir is beside Maloney hill with capacity of 1000m². The water is pumped directly from the water works treatment plants passing to the reservoir before distribution to places.

Keffi's population has grown rapidly during the last two decades to 242'768 according to 1991 population census. These people need food, housing, water and other human needs which have thus increased greatly especially with the increasing standard of living and purchasing power, so that the increased productive activities generated by, such demand have had tremendous impact on the need for water. The impact is

undoubtedly most intense in urban centers where the concentration of population and economic activities has been progressively greater.

Apart from the problem of water, keffi faces ecological problem (erosion, nature of soil drains tar from roads which have left keffi roads with potholes).

1.20 STATEMENT OF THE PROBLEMS

1. Inadequate water supply to the general public
2. Illegal connection to the water mains and vandalism of water supply facilities.
3. Inadequate funds for operating the water supply system.
4. Poor planning of water distribution systems.

1.30 AIM

Is to examine water supply system in keffi water works with a view to improve the quality and quantity of water distribution system

1.40 OBJECTIVES

1. To assess the distribution network
2. To identify the problems affecting water supply in keffi
3. To assess the adequacy of water supply
4. To suggest suitable ways of improvement
5. To ensure that work is properly planned before hand.

1.50 SCOPE AND LIMITATION

The study covers an appraisal of water supply, its distribution system, problems associated with and its control measures. Conclusion and recommendations are drawn based on available resources (data, money and time).

1.60 SIGNIFICANCE OF THE STUDY

It is hoped that the findings of the study will help the water board in developing future policies toward satisfying water consumers in supply and distribution

Water consumers will also find the study useful in appreciating the problems and difficulties the water board encountering in making good drinking water available.

It may also be significant to the management of water resources in reducing the problems faced in the scheme and to future research candidates on relevant issue, to be spring board for their project.

1.70 BIOGRAPHY OF THE STUDY AREA

1.71 BRIEF HISTORICAL BACKGROUND OF KEFFI (HOME OF PEACE, HOSPITALITY AND CENTER OF EDUCATION)

The story of cherished and glorified city and emirate called "Keffi", meaning fortification (pronounced Kepi) which the British characteristically adulterated to KEFFI, which was founded by Abdu Zanga in 1802 A.C. He first settled at a place called BAGAJI near present Keffi town, before he further pastured to Keffi area. Keffi can be likened to a sea of land under the meticulous surveillance of a lighthouse. Marooned, as it were, in the great expanse of plain, the hill (tsauni) which later named the MALONEY HILL becomes a long ranger surrounded by vast area of alluvial plain which serves as fertile farmland for the cattle rearers. The town viewed from the peak of Maloney hill presents a vivid picture of a calm sea devoid of violent rolling waves. This MALONEY HILL has a historical monument and it attracts tourists. It's so much blessed with vast and fertile land suitable for farming activities, etc

The inhabitants are mostly Fulani both Gudda and Bororo; others are: Hausa and Gwandara. The town is situated in open grass country. It is surrounded by a wall seven miles in circumference, in which there are nine gateways.

A certain Fulani of Zanga, by name Abdullahi (nick named Abdu Zanga), was in the habit of annually bringing his cattle to graze at the gate of the city of panda. Every wet season he returned with his cattle to

his town, Yan-tumaki Ward of Zanga district in Safana Local Government of Katsina State. In this, he followed the custom of his father, who was named MUHAMMAD GANI.

Captain Maloney came to Keffi from Bida where he had forced the then Etsu of Nupe to surrender his authority to the colonial Government for his alleged inability to put an end to slave-trade. When he came to Keffi, he discovered that the people did not accept the British rule. Faced with such a bluff by the people of Keffi; the only alternative open to captain Maloney was to declare war on them. During the war he came face to face with Magajin Keffi Ibrahim Dan Yamusa, the grandson of Abdu Zanga (Magaji Dan Yamusa), a fierce fighter and the son of Yamusa who had led the expedition against Zaria. Captain Maloney was killed at that war on Friday October 3, 1902. Today, the remains of captain Maloney still lies in grave paved with stones on Maloney Hill.

1.72 OCCUPATION

The inhabitants are mainly farmers, traders and artisans and has a rich cultural heritage that is manifest in its unique traditional arts and crafts which comprises:- Pottering, weaving, carving, Blacksmithing, Ternary, shoe-making, Butchering etc.

1.73 POPULATION

The population of Keffi Local Government Area by the 1991 population census is 242'768 and has an area of abut 2'050km² . . Keffi is heterogeneous in nature with tribes and languages living in harmony with one another. The major acceptable religion and occupation is Islam and Farming and trading.

1.74 AGRICULTURE

The economy of local government is agriculturally centered. Main crops grown include yams, rice, cassava, cotton, melon, ground-nuts, guinea-corn and Maize in addition to fruits like mangoes, cashew, citrus, guava which are grown in commercial quantities. It is an Industrial and economic development area due to its proximity to the federal capital territory Abuja.

1.75 TOURIST ATTRACTION

The famous captain Maloney hill located in Keffi town, stands as one of the tourist land marks, tie and dye pits, lake view resort and Keffi Central Mosque, an edifice of a structure, is a delight to the sight.

1.76 INFRASTRUCTURES (PHYSICAL AND SOCIAL)

Keffi enjoys the services of the following facilities: Banks, Hospitals and Clinics, Federal Medical Center, NEPA, NITEL, NIPOST, Nasarawa Broadcasting services (NBS) Booster Station, Pipe Borne Water, NTA link Station, NYSC Camp, Hotels like New Keffi Hotel, Gwaza Hotel, Lakeside view etc and Lodging and accommodations.

1.77 EDUCATION

The town (Keffi) enjoys the following education centres: Nasarawa State University, College of Arts, Science and Technology (CAST), School of Health Technology, Federal Government College, Government Science School Kofar-Housa, Government Day Secondary School Yelwa-Keffi, Gil Technical and Commercial Institute, St. James Institute, St. Peters Secondary School Privates and Public Nursery and Primary Schools.

1.78 MINERAL RESOURCES

Mineral resources like clay, tale, Gem Stones, Quartz, Mica, granites and aqua Marine.

1.79 CULTURAL ATTRIBUTES

- (a) YAN SHADI FESTIVAL: The bush Fulanis came to celebrate with their own town Fulani brothers and sisters every Sallah celebration. They perform various cultural acts at the Emir's palace for about two weeks.
- (b) TRADITIONAL BOXING: The boxers celebrate/display every Sallah and "CIKA-CIKI" periods at the Emir's Palace by Hausa.
- (c) YAN-SHANTU: This is a group of girls who come together with their Shantu, to sing and dance.

1.80 SECURITY

Keffi enjoys the services of the following security organizations: Nigerian Immigration Services, Nigerian Police Force, State Security Services, Crime Investigation Bureau, Nigerian Army (81 Guards Brigade Barracks), Nigerian Prisons Services, Federal Road Safety Corps, Vehicle Inspection Offices and Fire Brigade Services.

1.81 THE GEOGRAPHICAL BACKGROUND OF KEFFI

1.82 LOCATION

Keffi is the headquarter of Keffi Local Government Area of Nasarawa State. Keffi is one of the oldest local administrative units in the state having been in existence since the Native Authority days. The town is situated almost at the heart of the nation very close to Abuja. Keffi is presently located at the extreme south-western part of the state, it is bounded by Karu, Kokona L.G.A s and Sanga L.G.A. of Kaduna State, located to its West-East and North respectively. Keffi is approximately 1200 feet above sea level; and latitudes 7 degrees 50 minutes North and Longitudes 8 degrees 48 minutes east. Keffi local Government has an area of about 2050km² and population of 242'768 by 1991 census.

1.83 CLIMATE

Keffi environment is ultra conducive moderate, healthy and good climatic condition, similar to that of the Federal Capital Territory Abuja, Keffi experiences a tropical climate with two main seasons, wet and dry. Its climate is quite pleasant. A mean temperature of 60f and 80F maximum have so far been recorded. Dry season from November-March often accompanied by high temperatures and humid atmosphere most especially during the rainy season with occasional dust, harmattan winds which is dry, cold and strong blowing from North-East. The wet season, that is rainy season, is cold, lasting from April-October.

1.84 RAINFALL

Keffi's rain is seasonal, most of it falling between July and September. It is generally cool during the wet season which begin by April-October; and hot in the dry season with little or no rainfall from the

month of November to March which includes a dry dusty and cordial cold weather known as the harmattan (December to February).

1.85 HUMIDITY

In the dry season, there are differences in relative humidity in the eastern part of Nasarawa State due to altitude, but this disappears in the rainy season. The relative humidity shows much decrease from the early morning to the afternoon throughout the year associated with the high relative humidity. The cloudiness over the area is usually extensive. The daily average sunshine hours show the lowest values in the wet season.

1.86 WIND

The wind direction of Keffi is dominated by the seasonal movement of inter-tropical convergence zone, which represents the moving frontier between moist Atlantic air from the South-West and the North-East trade dry air from the Sahara.

1.87 TOPOGRAPHY

Nasarawa State is situated at the south of the Northern lowlands following the Benue River flood plains. Keffi is located on the latitude which runs across this broad plain that descends and extends gradually and gently into the bottom of the Atlantic Ocean by the Southern part of Nigeria.

1.88 SOIL

Keffi like other part of Nasarawa State is an assemblage of Basement-Metamorphic rocks, granite and basalt of two or more ages. The crystalline rock surface drops in step by step to the Northern part of the Northern low lands. This consists of rocks of basement complex covered by shallow soils and shows a number of "Inselbergs", out layer of granite.

Naturally, the over burden is derived from the crystalline rocks as a result of the process of laterization which has often occurred. An accommodation of iron and aluminum has taken place and soil type is generally impervious to water and it hardens by exposure to the surface.

1.89 VEGETATION

Keffi is situated at Guinea Savanna belt. The vegetation is much, which has sparse bush-lands covers mostly (by Northern gambler) during rainy season which has forced the vegetation to develop characteristics enabling it to resist fire.

The predominant plant cover is characterized by the discounting canopy of trees, shrubs, and grasses. Much of the area had its original cleared, due to construction and Agricultural practices as well as seasonal bush burning which normally occur during the dry seasons.

Among the common trees found here are the oil bean trees, the locust bean trees, oil bean trees, the shea-butter trees, the bamboo trees and Isober lieu trees. A large parts of the vegetation is made up of crops and pasture land, the most prominent crops farmed here are yams, rice, beans, guinea-corn, cassava and maize.

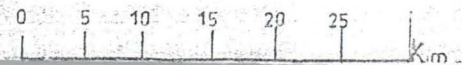
MAP OF NIGERIA SHOWING NASARAWA STATE

NIGER REPUBLIC



BENIN

CAMEROUN



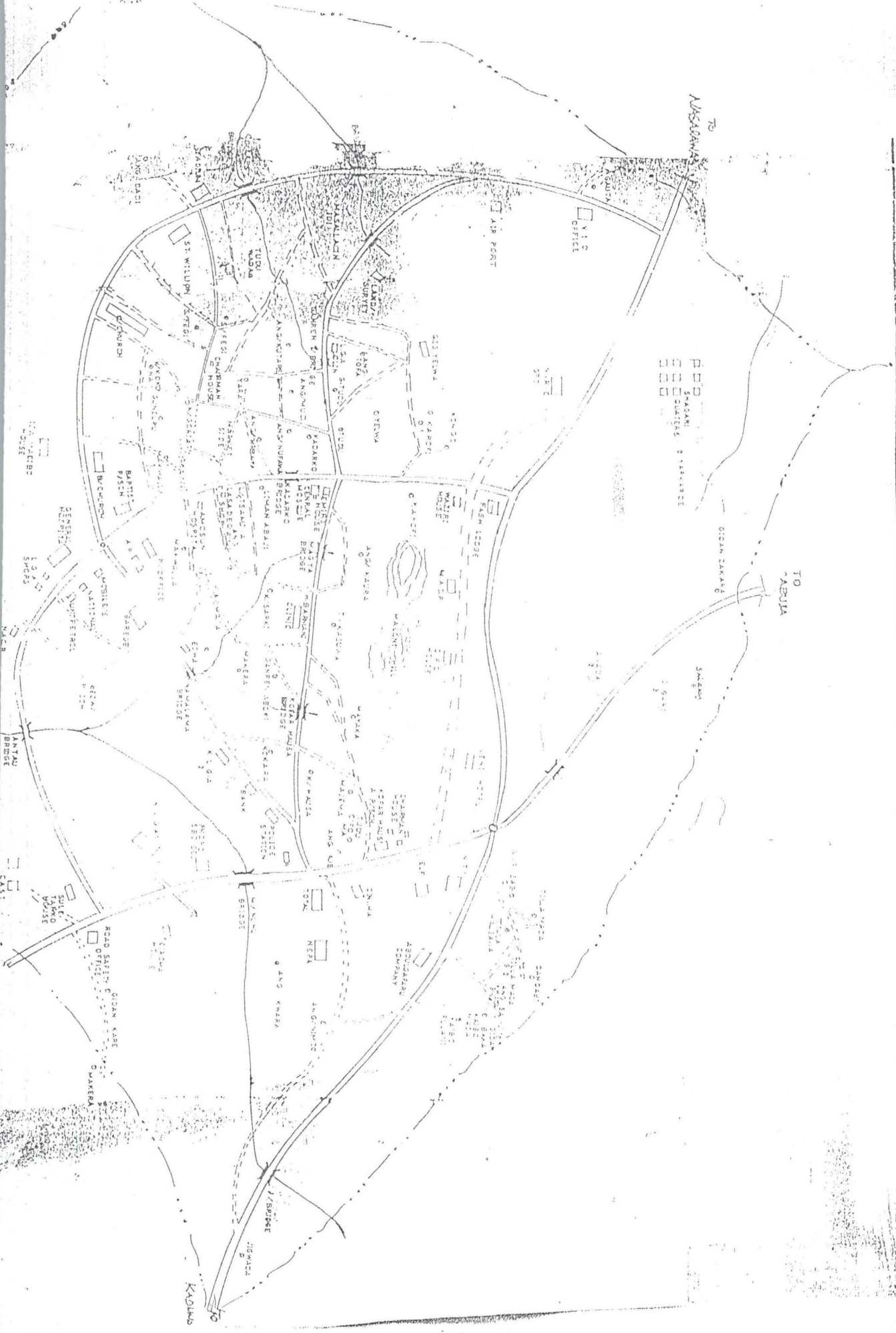
MAP OF NASARAWA STATE

SHOWING KEFFI LGA

SCALE 1:36,000



MAP OF KEFFI LOCAL GOVERNMENT AREA OF NASARAWA STATE



CHAPTER TWO

2.0 REVIEW OF RELATED LITERATURE

2.10 WATER SUPPLY SYSTEMS

Water-supply:- water is the most abundant chemical substance in the world. We obtain our water mainly from rivers, streams or springs. In areas away from these supplies, bore-holes or wells are needed to tap underground water. This is an area that causes too much, storage. It has been an area of many concerns, in respect to existence of mankind. Without water, life cannot survive.

The problem is not with the quality of water available but with collection and storage in order to cover seasonal variation and demand. The movement of water from area of surplus to area of shortage and the overall control and treatment of influent to avoid pollution and maintain the quality of water supply.

Sources from the books indicated that 70% or $\frac{3}{4}$ of the earth surface is covered with water. Yet evidence shows in Nigeria, social and economic problems caused by the shortage of water e.g. affect animals, fishing, crops, man, factory (coke, beer) construction industry.

Water supply systems consist of all the necessary installations required to obtain, treat and distribute water to the eventual users. The main features of water supply system includes:-

- (a) Source of water
- (b) Treatment Facilities
- (c) Distribution Systems.

The water supply for an urban area must meet the needs across all economic sectors. This include the needs for drinking and household uses, for public uses, and for emergencies such as fire fighting etc. Therefore, when planning for the capacities and characteristics of a water supply system in any community, it is necessary to make sure that there is enough water for different uses. In addition to the volumetric needs, it is essential to gather more detailed information such as water flow rate, the location of demand and the quality of the supplies. This information are relevant in planning for the right quantity and quality required by a given community. To meet the qualitative standard, water is expected to be free from visible suspended matter colour, taste, odour, objectionable dissolved matter and bacteria.

2.20 SOURCES OF WATER SUPPLY

Water of the land is classified according to whether it is surface water, flowing, exposed or ponded on the land, or sub-surface water occupying openings in the soil or rock. Water held in soil within a few feet of the surface is the soil water. Water held in the openings of the bedrock is referred to as ground water.

Water of oceans (salt water), atmosphere and lands moves in a great series of continuous interchanges of both geographic position and physical state which comprise the hydrological cycle.

The source of water includes: Rainfall, soil and underground water and surface water (rivers, lakes, dams and ponds). Of all these, rainfall occupies the peculiar position of being a natural resource and at the same time an element of the weather. We are considering the major sources of water supply which are ground water and surface water.

2.21 GROUND WATER AS A SOURCE

Ground water is the water found under-ground in its liquid or vapour state. It may also move between the soil and sub-soil grains. Ground water is that part of hydro cycle that is unseen to man in which case he cannot observe its movement, neither can any measurement be taken directly. The water from this source entirely takes care of any given community and is a mystery to man. In the sedimentary rock areas, more water is stored underground than is available on the surface. The provision here must rely more on the sinking of tube-well and bore-holes. In the areas of ancient rocks, the amount of ground water available is generally small.

2.22 SURFACE WATER AS A SOURCE

Surface water is that water seen in ponds, lakes, rivers, and seas. About half (1/2) of the surface area of Nigeria, including all or most of the Northern states and Oyo and Ondo states are made up of ancient, hard rocks into which water does not readily sink. Water in these areas is largely to be found at the surface of streams and rivers. The total amount of water flowing in these water courses is unknown, but is clearly very large. In these areas of ancient rocks, the provision of water has to rely largely on the control and management of the surface water resources through the construction of dams.

In the sedimentary rocks areas (most parts of Sokoto, Borno, Ebonyi, Delta, Imo etc) rain water sinks into the ground more readily, so that rivers are not as many as in the areas of ancient rocks.

2.30 QUALITY WATER SUPPLY

Water related infections such as diarrhea, dysentery and infectious skin and eye diseases continue to claim many lives and deform many others in the country. A lot of money has been expended on curing such diseases with regrettably often scant attention and minimal investments being directed at the prevention of such diseases by ensuring adequate provision of good quality drinking water through a water policy that will address adequately both issues of supply and demand rather than the existing supply oriented policies. Huge investments have been made by government to sink bore-holes with greater objective on supply. The supply oriented approach is reflected in the goals of national water supply policy:

- (i) To meet the basic needs of the population through the provision of accessible, safe, reliable and affordable water supply
- (ii) To meet water requirements of industrial, agricultural, commercial and institutional users to boost economic growth.

However, the question of adequate quality drinking water supply has probably been one of the main issues in the struggle to achieve better living standard and economic development. That is why several efforts were made at different levels to contribute to understanding and achieving adequate supply of water in the country as well as other places.

Akintola, F. O. and Areola, O. O (1980) noted the incidence of water scarcity in Ibadan city and attributed it to low capital investment by Government to water corporation as well as poor distribution network. This situation created disproportionate and inadequate water supply in the town.

Similarly, Hamidu, I. B. (1988) in a study of Yola metropolis discovered spatial inequalities in domestic water supply, which he attributed to the distribution system, technical disabilities and lack of adequate financial commitment as well as skilled manpower as major management deficiencies.

The above observation appeared similar to that of Ayoade, J. O. and Oyebande, L. (1978). The duo strongly observed that "perhaps the most water resource problem of the Nigerian environment is the control and

effective utilization of surplus seasonal water, both for areas where they fall as rain and for other needy areas. This involves the problem of comprehensive planning and operation of water development projects and adoption of conservation methods aimed at reducing avoidable losses and wasteful usage”.

2.40 WATER CONSERVATION

Conservation involves a whole lots of different adjustments and for efficient, economical and sustainable water supply, there is need for integrated and coordinated planning for conservation, utilization and control.

Therefore, if water is to be stored for use during the dry season (up to seven months) much of it will be lost to the atmosphere. It is for this reason that it is profitable to try to reduce such water losses by employing evaporation suppression controls. One such control involves the introduction or planting of trees around the margins of the reservoir site where they will serve both to intercept winds and produce shade. Thus, this implies landscaping the reservoir area.

Moreover, an extension of tree planting over the whole or part of the catchment area will afford valuable assistance in minimizing the danger of damage by flood water and reducing evaporation within the whole catchment area.

Evaporation rates can also be reduced through the introduction of certain plants such as the “water cabbage” of west Africa which is a free floating plant that grows very quickly in both running and stagnant water (Musa, 1994).

However, the issue of using plants in evaporation controls needs further investigations for in some cases the loss due to transpiration of plants is even greater than due to evaporation from free surface water. That is why this approach is more theoretical than practical.

2.50 WATER TREATMENT TECHNIQUE

Water treatment is normally done to ensure that its physical and chemical properties are brought within acceptable World Health Standards. Raw water therefore, undergoes a treatment process to enable it good for consumption.

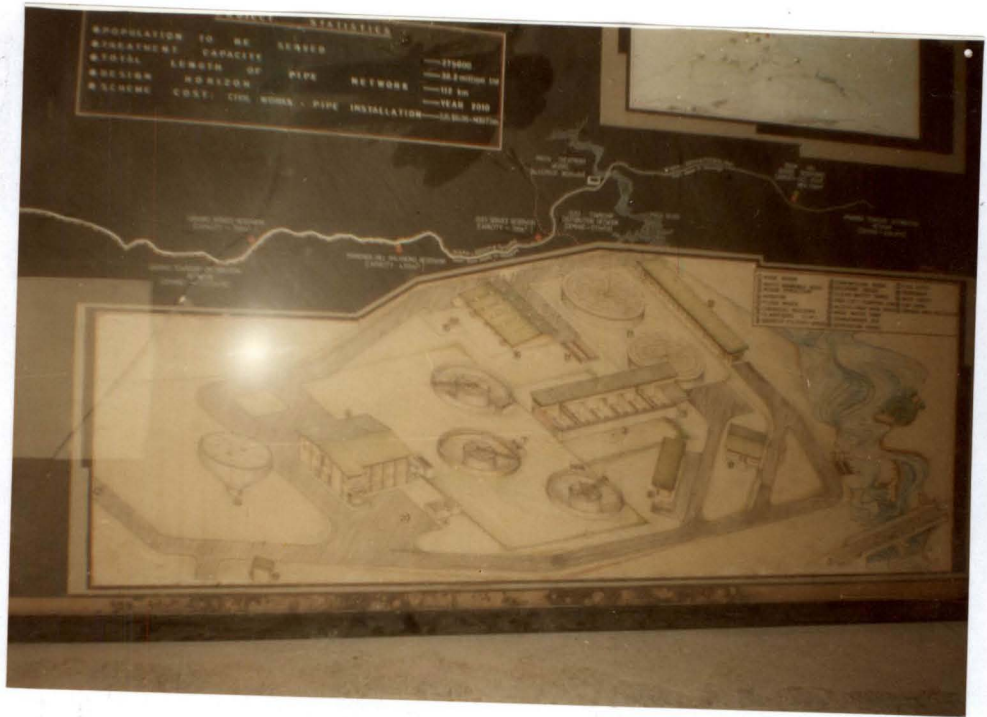
Drinking water should be free from bacteria or other contaminants. It should be clear, colourless, odourless, and pleasant to taste and contains a moderate amount of soluble mineral substances. Water in its natural stage seldom has this qualities. So after water is drained from a source, it is pumped into a treatment tank or plant. The character of treatment to which water is subjected to, in the treatment plant, vary with the quality and source of the water supply.

Nasarawa State in general has the same water characteristic. For this characteristic, the water is treated with four types of chemicals namely, the alum (Aluminum sulphate), lime (Calcium hydroxide), Chlorine (Calcium Hypochloride (HTH)) and Polyelectrolyte.

Here is the treatment procedure. Raw water from the river is pumped to the aerator where some gases as oxygen, carbon-dioxide, lead are expelled. The water is then passed to the flash Mixer, where aluminum Sulphate, calcium hydroxide and calcium-Hypochloride are introduced to water and mixed up. After mixing, it passes to clarifier where polyelectrolyte is introduced to aid coagulation at flocculation chamber. At this stage, flocculation and sedimentation takes place. The water passes to filtration chamber. Water coming from clarifies sink through gravity sand filter which have three media: sand, gravel and nozzle passes to the balance or clear water tank. It then goes to the treated water tank. It then goes to the treated water pumps.

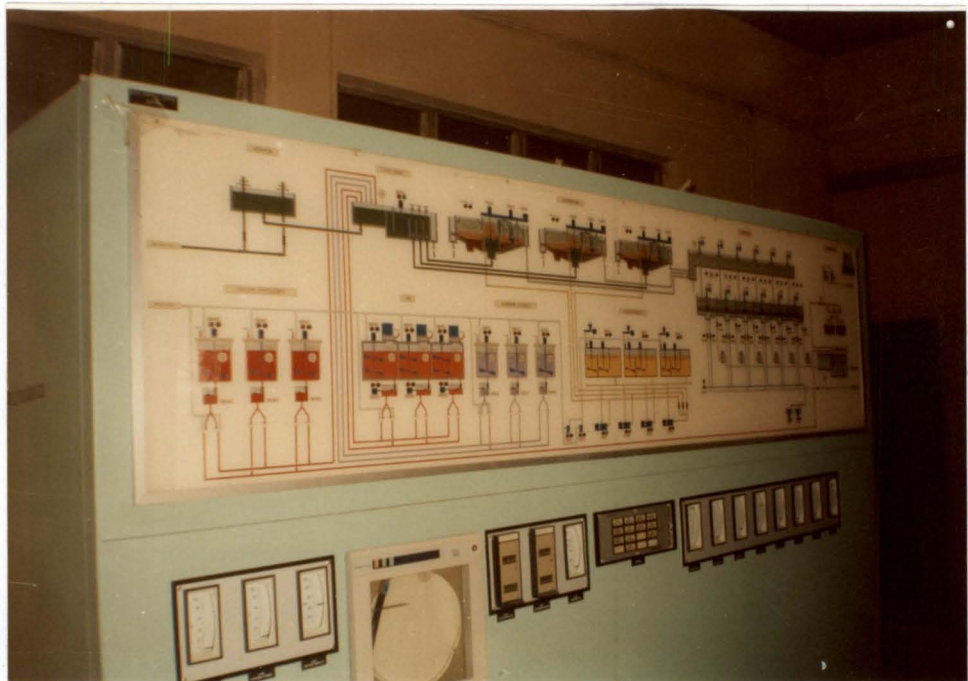
After the treatment, the laboratory Technologists has to carry-out the tests to ensure that the water is free of: acidity, turbidity, colour, odour, chlorine-residual, hardness etc. after the test, when the water is free of these, it is then ready for use and pumped to reservoirs before distributing to houses.

PLATE 1.



MASTER PLAN OF THE WATER WORKS

PLATE 2.



WATER TREATMENT PROCESSES

PLATE 3.



WATER WORKS MAIN SOURCE AND RAW WATER PUMPS MANTLED TO IT.

PLATE 4.



AERATOR, THE RAW WATER OUTLET

PLATE 5.



FLASH MIXER

PLATE 6.



CLARIFIER

PLATE 7.



FILTRATION

PLATE 8.



CHLORINATION

PLATE 9.



*BALANCE/CLEAR WATER TANKS. EACH TANK HAS THE CAPACITY OF 4300M**3.*

PLATE 10.



RUST FREE WATER STORAGE TAN

2.60 WATER DISTRIBUTION SYSTEM

The distribution of water in any town is done to better the living condition of the inhabitants. Good water constitutes an essential aspect of socio-economic welfare of the people, since it forms the largest component of most living matter. Water makes life possible, as such, the distribution should be in such a way that all inhabitants will benefit from it.

After water has been treated, it need to be delivered in light quality and pressure from the pumping stations, wells or the end of the transmission conduct to the consumers' premises and fire hydrants through appropriate distribution systems.

1. The gravity system in which the water source is, is at an elevation above the community sufficiently high that adequate pressure is directly available
2. The distributive reservoir whose elevation enable the water to flow by gravity through the channel.
3. The direct pressure system where water is pumped directly into pipe or mains.

2.70 STANDARD USED IN THE PROVISION OF WATER SUPPLY

2.71. DESIGN STANDARDS

The provision of water supply in any area must follow certain standards which are first put into consideration to determine the suitability, comfortability, efficiency and effectiveness of the water supply in that area, so that the water being supplied should not be over used or under used due to population increase or decrease. Human being requires water for three basic purposes. Viz:

2.72. DOMESTIC WATER REQUIREMENTS

For satisfying basic life requirement like drinking and cooking. Minimum human physiological need daily is two litres "(WHO 1972, valentine 1967). The main need for modern living is fifty litres per head per day "(Fair et, al ' 1966). If there is no restriction, domestic requirement will vary according to standard of living.

1. Sanitation Requirements:- For bathing and for all washing. The normal requirement per head, per day are as follows:-
 - (a) Bathing 40 litres
 - (b) Washing 100 litres
 - (c) Flushing Toilet 45 litres
 - (d) Scrubbing and Dusting 5 litres

(Oluwande, 1973)
2. Comfort requirements:- Domestic air-conditioning require up to 150 litres per head per day.

2.73. AGRICULTURAL USES REQUIREMENT

The quantity requires will depend on the type of farming where mixed farming is practiced more water is required. There are two (2) main uses of water for farming: viz:

(a) WATER FOR CROP IRRIGATION

A lot of literature exist on water requirement for irrigation in the tropical area, (March 1967, Pillsbury 1968, Booker 1967, Hagan et al 1968). The quantity and quality of water required vary according to the type of crops, soil and climatic condition.

(b) LIVESTOCK REQUIREMENTS

The quantity of water required ought to be the same as that of human being. The quantity depend on types of animals.

TABLE 1.

S/No.	Types of Animals	Water Quantity Per Head Per Day
1	Cows	Up to 150 litres per head per day
2.	Horses	Up to 50 litres per head per day
3.	Sheep	Up to 10 litres per head per day
4.	Goat	Up to 7.5 litres per head per day
5.	Chicks	Up to 5 litres per head per day
6.	Pigs	Up to 1.5 litres per head per day.

Source: Water Engineers Manual (1970), Brick Land (1952).

2.74 INDUSTRIAL USES REQUIREMENTS

The quantity and quality requires depend on the type of industry. The requirement of water in industries will come under one or more of the following headings:-

- (a) For Cooking 100 tones of water
- (b) For Washing 10 tones of water
- (c) For Power generation

Hydro-electricity is an important source of power in the developing countries. Some of the leading hydro-electricity schemes in the developing

Countries at the Kaniba in Zambia-Rhodesia. The ASWAN over River Nile in Egypt; the Kanji" over River Niger in Nigeria.

2.80. MANAGEMENT OF WATER RESOURCES

Water is the world's most important resource. This resource is already under extreme stress. To safeguard the lives of future generations in this area and to ensure adequate access to water supplies for agriculture, domestic and other purposes, sustainable water management measures were needed yesterday, but are still receiving only scant consideration today.

Water resources have certain characteristics which must be taken into account to ensure good management. Management of water resource is a critically important human activity. The quality and availability of water determine the levels of public health, food production, the productivity of industry(ies), the production of energy and other important aspect of the quality of life.

By management of water is meant people's control of water as it passes through its natural cycle with balanced attention to maximizing economic, social and environmental benefits.

Since planning is one of the most important tasks of management, it follows that planning for water management is a critical activity. The basic difficulty is conflict. This has always been true as even primitive societies taught over scarce water. Now the conflicts are more sophisticated but are still there. Effective water planning is sometime difficult and over coming the problems is one of the chief objectives of water planners.

The primary need for water resources management arises from the basic fact that the hydrological cycle does not adopt itself to man's requirement for water over space. The objectives of water supply management therefore achieved convergence between water availability and demand in both space, and time through the modification of the hydrological cycle. This involve not only the beneficial use of water

resources but also the prevention, avoidance or minimization of the effects of water excess (flood), water deficiency (drought) or water pollution. Water conservation is therefore an important aspect of water resources management. The conservation measures involves a whole host of different adjustments through control of evaporation loss from reservoirs, improved efficiency of distribution system, the elimination or reduction of wasteful use of water and under precarious conditions, the recycling of waste water.

Before comprehensive water resource planning and management can be successfully carried out, the awareness of the need to plan and manage water must find expression in urban, regional or national water policy that address both supply and its driving force-demand (Oyebande, 1975). The issue of demand which should be the cornerstone seemed to have inadequately been reflected in the policy. Demand is largely Based on Social and economic characteristics of the population which are highly variable within urban setting while the supply-oriented approach rather seemed technical-cum-ecological (physical) directly dealing with source. The Socio-economic characteristics help to pass judgement on such indices as efficiency and affordability of water supply services.

2.90 THE IMPORTANCE OF WATER

Water Supply is the most important of the urban water services and constitute a primary need for people everywhere. Good water constitutes an essential aspect of Socio-economic welfare since it forms the largest Component of most living matter.

Water makes life possible, as without it, life and civilization can not develop or survive.

Water forms the largest part of most living matter. An average man is two-third ($2/3$) water and would weight only 13kgs when he is completely without water. Plant on which man depends for his food can not grow without water. They need it for photosynthesis and they take their nutrient from the soil in solution. Three quarters ($3/4$) of the surface materials on the earth's crust consist of water. It is an important geomorphic agent playing a significant role in weathering and in the formation and modification of land regulation in the heat budget of the earth.

Man can not survive without water. Water is a vital need to man just as air that we breathe, water is the most important element to man. He can survive longer without food than without water. Man requires fresh water for life, health and welfare. If this vital life-survival is greatly threatened. The quality and quantity of water is not only deteriorating but also declining.

Day air extracts one to two kilograms of water daily from the human body. This water must be replaced. An average man for drinking. Man requires water for various uses such as cooking, washing, sanctification, agriculture, industrial, production, hydroelectric power etc.

As man standard of living increases so does this need for and consumption of water.

The role of water in human activities is quite significant considering the various support activities which are dependent on the availability of water supply, not only does water remain an indispensable element of life, much of man's efforts to survive and progress physically and socio-economically are dependent on adequate water supply. However, because it is freely available in streams and rivers and through falling precipitation, water has too often been taken for granted and mismanaged. Only in water deficient areas, is water accorded its due recognition as a valuable resource.

2.90 IMPACTS ON WATER ENVIRONMENT

This address the various aspects of the environment on which man's actions are evidenced. Projects such as construction of power plants, reservoirs, industrial premises will cause short-term impacts on the water environment while their operation will result in long-term impacts causing hydrologic changes and water pollution in either situation.

Water pollution occurs when there are concentration of particular pollutants in water for sufficient period of time to cause certain effects.

The categories of pollutants which could have deleterious effects on water quality include:

1. Alkalinity and acidity
2. Detergents
3. Floating materials
4. Coloured matter
5. Organic matter
6. Non biodegradable organic materials
7. Heated liquids
8. Suspended solid
9. Mineral salt
10. Toxic chemicals
11. Algal nutrients
12. Foaming agents
13. Bacterial and viruses

The term "contamination" appropriately refers to health related effects such as those caused by pathogenic bacterial intrusion. Aesthetically displeasing effects created by oils, grease, or other floating materials result in nuisance.

Considering of potential water impacts should be based on a clear delineation of various water quality characteristics. For example, water quality can be described using physical, chemical, inorganic and bacteriological parameters or criteria.

There are physical parameters as odour, colour, temperature, solids(residues), oils and grease. In surface water courses, colour, oil and grease are of concern in relation to nuisance considerations.

Chemical parameters comprise organic and inorganic constituents. The most used test to describe the organic content of as the amount of oxygen demand (BOD), which is defined as the amount of oxygen required by bacterial in a sample under aerobic condition at 20c over a 5- day incubation period(canter L.W.1977). soluble organic as represented by high BOD waste, cause depletion of oxygen.

Inorganic parameters in water quality considerations include salinity, hardness, alkalinity, acidity and the content of iron, chlorides, nitrogen and phosphorous among others. Acid, alkalis and toxic substances for example have the potential for causing fish kills and creating other imbalances in stream ecosystems.

Bacteriological parameters include coliforms, fecal coliform and viruses among others. Total coliform and fecal coliform organisms are used as

indicators of the presence of pathogens. Water pollutants on receiving water quality can be expected to have such other effect as:

- 1) Causing or increasing corrosion of surfaces with which the water comes into contact.
- 2) Encouraging the growth of undesirable biological life, often in excessive quantities.
- 3) Interfering with the recreational uses of water for bathing, boating, etc.
- 4) Rendering the water unsuitable for other uses such as industrial and irrigation purposes.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 DATA

To achieve the stated aim, the project was carried out first by reconnaissance survey and that was to make oneself conversant with the area in question;

also to know the physical outlook and location of the existing water facilities in the town. Data were collected through the following difference sources:

3.10 FIELD RECONNAISSANCE SURVEY

Reconnaissance survey was carried out to identify bore-holes, shallow/concrete wells, the low cost housing estate and schools like college of Art, science and Technology, Federal Government college, and School of Health Technology all in Keffi in order to asses existing water resources, demand and supply within the study area. Visits were made to some Title holders of Keffi, Keffi Local Government works Department and information unit; for the Biography of the study area (Keffi); and retired Keffi water works staff who are residing in Keffi. All the visits were fruitful and they gave me maximum cooperation by giving the necessary information needed .

3.20 MAPS AND PHOTOGRAPHS

Photographs were taken in the existing water works, bore-holes well, tap-water etc. maps were also drawn to show the location of the study area, which include map of Nigeria showing the position of Nasarawa state, that of Nasarawa state showing keffi local Government council and map of keffi local Government council.

3.30 LIBRARY RESEARCH.

Library research in write ups in the subject such as standard text-books, journal publication seminar papers presented by qualified professionals and the use of lecture notes.

3.40 HOUSEHOLD SURVEY

Household survey was conducted to obtain data on socio-economic and population characteristics of the inhabitants. It was also used to assess

the level and distribution of water supply and demand in different parts of the town.

For the purpose of this study, Keffi town was divided into six wards in view of their socio-economic and water demand disparities namely, Goriya, Yara I&II, Unguwar Rimi, Tudun-Kofa and Gangarren Tudu, Iya I&II and Liman-Abuji.

3.50 SAMPLE SELECTION

In order to estimate the present population of Keffi and other aspects of the research, systematic Random sampling techniques was used. A total of 350 households representing 2% of the estimated number of household in Keffi have been sampled for purpose of this study. in this an average household size of seven persons has been arrive at the overall population estimated of keffi town.

1.60 QUESTIONNAIRE

A standard questionnaire was drafted to ensure uniformity in operation and the ways and manner it is to be administered. Also to ensure consistencies so that when responses are made the same question, when comparing the responses, one is comparing responses to the same questions.

Two sets of questionnaires were administered according to data required. Questionnaire "A" was purely technical and was administered at Water Board while questionnaire "B" was administered on sample households for information on demand and supply as well as satisfaction or otherwise with the water supply situation in the area.

The questionnaire "A" was to obtain data on the mode of operations, level of inter-agency interaction, problems encountered and general proposals.

3.70 DIRECT INTERVIEW

Personal interview (survey method)- This method is useful to me during my survey. I determined the validity of what the respondent was saying, whether sounding right or not. It was quicker, within the shortest possible time to obtain the pertinent information required from the respondent.

Informal interview with people, staff and professionals on water resources and supply was carried out continuously during the field work.

3.80 OBSERVATION

I observed some of the information needed by taking note of the activities going on especially in the area office and in the laboratory during the course of my interview at the treatment plant. This enable me to confirm some of the information supplied orally by the laboratory technologists. An opportunity for me to observed how the plants (machines) operates and work..

3.90 SAMPLING REPRESENTATION

For equal representation of all parts of the study area in the sample, some number of questions were randomly administered in these wards of the town viz as shown on table 2 below.

TABLE 2

S/N O	WARD	NUMBER	PERCENTAGE (%)
1.	Goriya	60	17.14
2.	Iya I&II	70	20.00
3.	Tudun kofa and Gangaren tudu	60	17.14
4.	Yara	50	17.14
5.	Liman. Abaji	50	14.30
6	Ungwar rimi	50	14.30
	TOTAL	350	100

SOURCE: field survey January 2001.

CHAPTER FOUR

4.0 DATA ANALYSIS AND PRESENTATION

This chapter intend to discuss on the Biography and existing situation on the study area, and also to analyze all the relevant data collected from the field survey with a view to identify the various problems associated with supply of water, distribution and its treatment in the study area (Keffi water works)

4.10 BRIEF ANALYSIS OF KEFFI WATER WORKS.

The Keffi old water works was established and commissioned in 1954 by the Premier of Northern Nigeria, Sir, Ahmadu Bello, the Sardauna of Sokoto. The treatment plant is at old Army Barrack, mile 5 along Keffi-Akwanga road, which has a capacity of $2784\text{m}^3/\text{d}$, while the reservoirs are situated beside Maloney hill and Government Reservation Area (GRA) with the capacity of 1000m^3 respectively. The source of this treatment plant is from river Kaduna.

Before establishment, the ministry of works was in charge of water supply to the entire community. Keffi Local Government got their water from the board through the main pipes that was laid all over the town. Individuasl now made their connections from the pipelines of the board. The water provision was adequate but as far as 1970s, there was a tremendous increase in population due to coming back of 46 Battalion of Nigeria Army from civil war in the eastern part of Nigeria and the establishment of the School of Preliminary Studies (SPS) Keffi. Thousands of army returned and also students admitted were coming-in, these has led to shortage of water supply.

Because of these problems, a very large and deep pond of water was created to serve Keffi town with water supply by one company called "The Inter- contractor Company Nigeria Limited. 50% of the water problems by then have been solved. With the rapid growth of population in Keffi, which is one of the satellite towns to Abuja the federal capital territory; and also due to its proximity, some constructions workers and other Federal Ministries that packed to Abuja from Lagos were resident there. Most other people who could not find accommodation in Abuja also resides there.

In the light of the above, during the regime of late General Sani Abacha, the Federal and State Governments contributed and constructed a new Keffi water works/treatment plant at river Mada at Gudi 54km from Keffi; along Keffi-Akwanga road which was commissioned on May 22 1996 to improve the services of water supply to Keffi and Akwanga Local Government Areas. It has the treatment capacity of 38.2 million l/d. River Gudi has three (3) sources namely: River forest, River Kura-falls and River Kaduna.

The plant pumping the water to Keffi new Maloney hill reservoir which has the capacity of 12, 500m³ and to Akwanga, new Mada hill service reservoir with a capacity of 1,350m³. Keffi township distribution network demand is 29'551m³/df and the design horizon is year 2010. The water is pumped for 10hrs to Maloney hill reservoir per day and takes 16hrs before filling it. About 1500cm³/hr of raw water was pumped from the river.

PLATE 11.



OLD MALONEY HILL SERVICE RESERVOIR (GROUND CEMENT)
CAPACITY 1000M**3.

PLATE 12.



NEW MALONEY HILL SERVICE RESERVOIR. CAPACITY
12'500M**3

PLATE 13.



G.R.A. ELEVATED RESERVOIR. CAPACITY 900M**3

4.20 WATER SITUATION

The present source of water supply to Keffi town is from Mada river at Gudi, where the public water supply for the town was initiated with the construction of a new DAM to satisfy the water needs of the town, which has grown very rapidly. The water consumption increased rapidly. Before construction of this new Dam, 45% of the population drew their water from great number of ponds and wells such ponds as Abati, Agwadu, Dan dauda, Antau, Bala-na-jaja, Rafin-sanyi etc.

Presently, available water is not supplied equally throughout the town. Rather, the Government Reservation Area (GRA), and the new layouts where the rich and powerful people live, have a greater share of the water. In the past, before the new treatment plant, during the dry season no compound has water on more than four days in the month on average and, even then, water flow lasts from only one to three hours per day.

In these circumstances, tap water is a precious commodity which has to be stored up in tanks, pots and plastic containers in each house hold and carefully rationed for drinking. These supplies are often supplemented, during the rainy season, with rain water caught off the roofs of the houses.

About 65% of the houses where households reside are connected with public pipe-borne water supply system and 35% are not. These connected only a negligible proportion (5%) have 24hours daily water supply although the pressure may vary temporally. Most people kept night vigil in order to get water. This loss of sleep certainly have debilitating effect on human health and this could be worse for primary and secondary school pupils who wake up between 3 and 4am daily and yet are expected to stay awake in class at 8.00am. Water for other domestic uses is either bought from water tankers and water vendors (MAI RUWA) whose supplies are from unknown sources and therefore not safe; or from hand-dug wells. How safely located are these wells from the pit toilets given the layouts? Both wells and supply through "MAI RUWA"/vendors have their problems in terms of the water quality. The relationship between unsafe and diseases such as cholera, diarrhea, visible skin diseases have been emphasized.

4.30 EXISTING DISTRIBUTION PATTERN

It is distributed to the community from the service reservoir through a 600mm water main which feeds the 200mm, 100mm, and 800mm water pipes. The distribution system also include the 60mm branches which serve private buildings. When there is water shortage, some people trek for a far distance before they could get water and those that have wells will depend on them. At the same time, the Local Government water tankers and other privates go to Nasarawa water works or Abuja to draw water for some public institutions and individuals. There are more than one hundred and fifty public taps out of which one hundred and twenty-five are functioning. There is a schematic way of distributing water to the town. The town has water almost everyday for six to eight hours supply.

4.40 EXISTING WATER CONSUMPTION.

SOURCE OF WATER SUPPLY

TABLE 3

S/NO	CATEGORIES	NUMBER OF RESPONSE	Percentage (%)
1.	Pipe borne water	65	65
2.	Stream	5	5
3.	Wells	20	20
4.	Combination	10	10
TOTAL		100	100

Source: field survey 2001

As revealed by the field survey, 65% of the household rely on pipe borne water, while 10% use combination of pipe borne water with other sources, 5% use stream, and 20% rely on well as their source of water. The conclusion from table 3 is that only 75%, that is those who uses pipe borne water and the combined source like pipe water and those other sources of water supply of the household survey make use of the 29'551 litres of water consumed daily.

Among the people that depend on tap water as their source, about 65% of the household depend on the private tap while 35% depend on the public tap as their source of water. This makes the people to travel far for water from their houses.

4.50 SOURCES OF FINANCE OF WATER PROJECTS

It was revealed through the questionnaire administered that pipe borne water supplied from the bore-hole was purely financed by the Nasarawa state Government, through the state utilities board, while water from other sources such as wells, are obtained through self-help efforts, and the assistance of the State and Local Government and the Directorate of Food, Roads and Rural Infrastructures (DFRRI).

4.51 GOVERNMENT FUNDING

Government allocation of fund to the area office for the purchase of diesel and maintenance have not been encouraging, as it has been the case with other boards and parastatals. Therefore, government needs to increase the grants to the scheme, since it has increased the water rate by 100%.

4.60. WATER SHORTAGE

Water is a necessity to life.

Water scarcity itself is an environmental problem and efforts to solve the problem often generate quite a number of other environmental issues. Given the number of deep and intermediate level bore-holes that have been sunk both by government and international donor agencies in the area, it becomes apparent that the present ratio of ground-surface water consumption cannot be sustained. Locally, ground water mining is occurring more than the rate of recharge, probably leading to a decline in future water yields. The fast rate of depletion of underground water passes a serious environmental challenge in view of the scanty and extremely seasonality of the area's rainfall resources inline with the principles of sustainable development.

Water shortage in the past in Keffi was caused by "insufficient development and inadequate management of available surface water and ground water resources". The area recorded a high failure-rate of water wells/bore-holes and also suffered from perennial water shortage due to poor maintenance of ponds and water wells. This shows that all the problems of water supply can be reduced to two: the problem of funding and technical expertise.

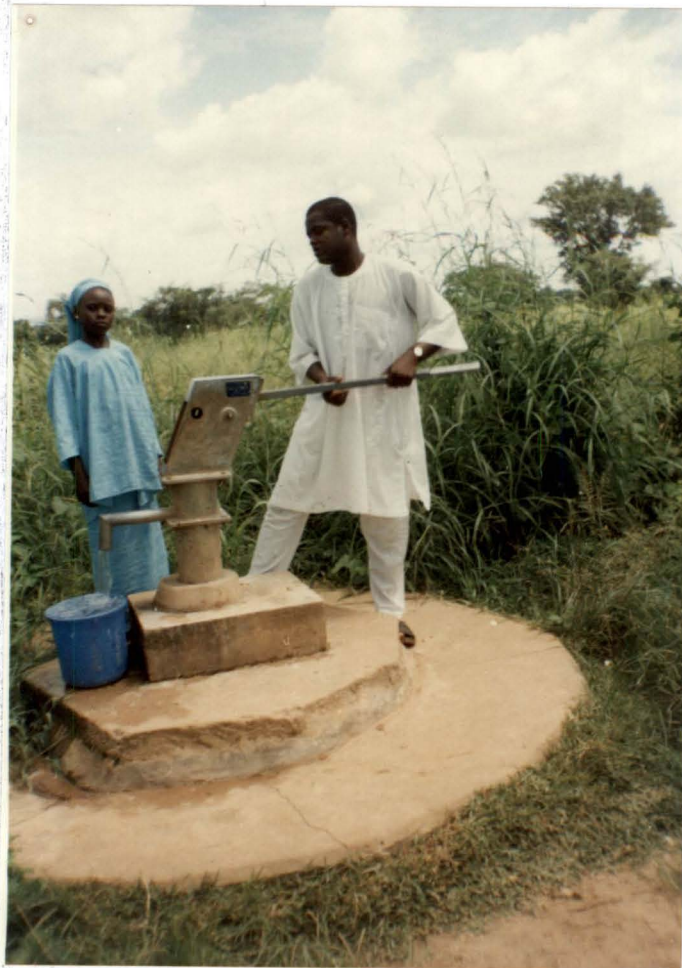
The shortage of water as revealed by officials of the Nasarawa state water Board is linked to frequent pipe bursts due to water pressure, this

is in the other parts of the state. In the case of the bore-holes sunked, the official attributed it to mechanical faults.

The water shortage problems in Keffi has been improved with the introduction of the new treatment plant by the government.

Ayoade J.O and Oyebande L,(1978) Duo rightly attributed the problem of water shortage to lack of proper planning. They attributed the problem of management to inadequate budgetary allocation by state and federal government to fund water corporations in the country. Thus, they indicated that while budgetary allocation to water supply sectors was reducing.

PLATE 14



BORE-HOLE AS A SOURCE

CONDITION OF FACILITIES

The provision of good facilities enhance good management of the scheme. As such, from the survey conducted, facilities are of good qualities and met the standard.

TREATMENT PLANT

Water treatment is normally done to ensure that its physical and chemical properties are brought within acceptable World Health Standards. Raw water undergoes a treatment process to enable it good for consumption. Survey shows that they all met the requirements.

RESERVOIR

Reservoir is where water is stored pending when it will be released for consumption. The water supply scheme in Keffi have two reservoirs: one at Maloney hill while the other at GRA. The survey revealed that, the two capacities are adequate, if they were to be filled and distributed the whole. But they only filled half or three quarter of the capacity.

WATER RATES

Water supply in Keffi is discovered to be a problem because of its inability to generate much revenue. The management find it difficult to collect water rates from the consumers.

SOURCE OF POWER SUPPLY

The water supply scheme uses a diesel generated machine which results in irregular water supply due to inadequate supply of the fuels (diesel). It is discovered that most of the time the fuel is not supplied no water will be supplied. The survey revealed that the state government have tried and linked it with NEPA. Once NEPA took off their light, the generated machine will take-up.

ANALYSIS OF WATER SUPPLY SOURCE

The source of Keffi water supply scheme is the Mada river at Gudi which flows from three sources (river kura falls, river forest and river Kadona), downwards to join the River Benue. This river seems not to dry up throughout the season.

WATER DISTRIBUTION NETWORK

The basic elements required for efficient water distribution include treatment plant, trunk main, reservoir, secondary mains and street service main from the survey conducted, all these are efficient.

STRENGTH OF PERSONNEL

The survey revealed that there are a total of thirteen staff currently working with the Area office, they are:

1.	Area water engineer	1No
2.	Establishment officer	1No
3.	Maintenance officer	1No
4.	Commercial officer	1No
5.	Plumbers	6No
6.	Securities	2No
7.	Revenue officer	1No

The survey revealed that only four out of the total staff are skilled personnel while the rest nine are unskilled. With this number, there will not be efficiencies and adequate productivity.

4.70 SUMMARY OF FINDINGS

PROBLEMS ASSOCIATED WITH WATER SUPPLY IN KEFFI TOWN- AS understood from the data analysis, the following problems have been found to exist.

1. Irregular water supply: From the analysis so far, it was discovered that, there is inadequate supply in Keffi; the people that depend on pipe borne water still complain about the irregularity of water supply from the board in-charge, compare the existing population growth rate to the water supplied pumped for ten hours every day instead of twenty four hours services.
2. Seasonality: From the analysis so far, it has been discovered that water shortage is attributed to the effect of seasonality. In the dry season, the water table goes low, most streams and wells get dried up and bore-holes sunked. Hence people who depend on other sources of water supply are hard hit. The problem alone will have to gear the government to give enough money to the board so that they can improve in their system of water conservation and reservation for long period.

3. Poor participation of the public for payment of the water rate: The locally generated revenue is grossly inadequate to enable the scheme to sustain itself. The management finds it difficult to collect water rates from the customers when NEPA take off light, the scheme uses a diesel generated machine when there is no money to fuel the machine, which means the supply of water has to stop. The survey revealed that the scheme depends mostly on the fund provided by the government to buy fuel.
4. Water spillage: Before the construction of the new treatment plant, the board is linked to frequent pipe burst due to water pressure on the old pipelines. The scheme have been discovered to be poorly funded, which have resulted to failure in the management system. Managerial capabilities have also reduced the scheme to a white-wash project.
5. Insufficient facilities and equipment: The provision of good management of the scheme. The materials needed to detect faults and repairs of damages on pipes are not adequate in the area office. But at the new treatment plant, the facilities are of good standard qualities.

In the case of treatment materials, it was discovered at the water works that chemicals that could be used for water treatment and preservation of the stored water are mostly not readily available.

6. Poor maintenance culture: The impatriotic plumbers make illegal connection without any permission from the water board. They cause a lot of damages to water pipes. They break tar roads without obtaining permission from the ministry of works. It was discovered/observed that this illegal; connection has vandalized some of the water supply facilities, Vandalizing the asbestos pipeline laid from the old treatment plant.

Similarly, the ministry of works and the Local Government Council workers when rehabilitating bad roads in the town, damages some of the pipes. That is, the water's main distributing pipes.

7. Inadequate staff Strength: Evidence has shown that there was a very small number of workers at the treatment plant in the Keffi area office, both skilled and unskilled, who will enhance

efficiency and effectiveness in the management and maintenance of the scheme; compared to the number of workers that are supposed to be employed in such an important management.

8. Poor planning and design of water distribution system: This is true, because when you take a look at the distribution network of the main water through the town, one discovered that some of the pipes were not properly laid and there was uneven distribution of the water supply in the town.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATION

5.10 CONCLUSION

The essence of water supply in any settled environment need not be over emphasized. A part from the role water plays in the socio-economic welfare of people, life cannot develop or survive without it.

Water has to be provided to the people due to the usefulness they derive from it. For Keffi town to possess the following qualities, that is proper living condition, comfort, health etc adequate water has to be provided for proper functioning. These can only be successful if the recommendations made are considered and fully implemented.

The level of operation and extent of management of this infrastructure, varies from place to place. This variation is the operation and management of water supply, indicating the need for management of facilities.

The research revealed some problems associated with the management of the scheme, in the form of irregular water supply, inadequate fund and water distribution within the town. It is hoped that this project will help in reducing or completely eliminating the problems faced by the management in the operation and management of the scheme and therefore make it a viable venture. It is also hoped that scholars and future research candidates on relevant issue will find it as a useful spring board for their project.

However, one of the essential purpose of this study is to propose effective machinery for implementation policies for water supply and distribution into reality as well as propose framework for managing these policies on a sustainable basis.

Considering the amount of funds (US & 14.96 plus N=39.7)m. and efforts required for the construction and installation of water supply facilities in Keffi water works, there is need for efficient arrangement which should reflect participation of various consumers and producers of water services such as governmental organizations and community based-organizations.

Moreover, in the control of water supply project of this magnitude, the benefits of participation derived not only from cost reduction and resource mobilization during implementation. It also forms more effective targeting of water schemes to the real existing and future needs of the residents of Keffi town.

Similarly, it enhances "user-ownership" of water supply facilities. Consequently, helping to ensure fuller and more efficient water use, better maintenance and more reliable and continuous operations.

5.20 RECOMMENDATIONS

At this point, participation or civic engagement requires the establishment and strengthening of participatory mechanisms which will ensure that all voices are heard in identifying problems and priorities, setting goals, exercising legal rights, determining service standards, mobilizing resources and implementing policies of the water supply system and distribution in Keffi town.

As indicated in the data analysis and summary findings, the management problems of water supply in Keffi town was well mentioned. The problem could be improved if the following recommendations are strictly followed.

1. Increase in water supply: The information got from water treatment plant shows that the scheme has been designed to provide 38.2 million litres of water per day, if the reservoir is working or operating simultaneously. Maloney hill service reservoir is which designed to supply Keffi town, has capacity of $12'500\text{m}^3$ and the township distribution network is $29,551\text{m}^3$. This is below the minimum amount of water required for daily consumption in Keffi. The design Horizon of the plant is year 2010, after this the capacity of the collection and treatment plant to be increased. The raw water storage reservoir and pumping station are also to be expanded to capacities similar to the collection or treatment plant.
2. Provision of more public finance: With the collection capacity of water supply system, there is need to have an effective distribution system. The local government and community should also be involved in the management of the scheme in terms of contribution of resources to make it more effective.
3. Provision of hand pump bore holes and deep bore holes: These should be located on strategic places in the town, possibly the areas where there is vandalisation of the existing pipes which is as a result of hand operation. This will even be easier to operate by the public. This will at the same time serve a large population in the area.

4. Adequate fund should be provided: The Government should provide enough fund for the running of the water board, so as to enhance the effective operation of the scheme. This will enable the board to have enough equipment which include machines for treating water, enough chemicals, vehicles for conveying the materials or facilities from the head office to the treatment plant etc. for better improvement in both the supply system and the distribution network.

The government should desist from political interference in funding the scheme, this will sabotage the development of the state.

5. Public awareness: There should be public enlightenment by the government on the use of water, the need to maintain water supply equipment and the payment of water rates. The payment is used in settling the light bill, wages, buying chemicals and buying of fuel (diesel) for proper maintenance.
6. More personnel should be employed: Nasarawa State Government should ensure proper management of the scheme through the employment of skilled and technical personnel. In the questionnaires administered, it was discovered that there was no enough engineers to help in the frequent maintenance of equipment for water treatment for effective supply of water, besides, the problem of mechanical breakdown will be overcome. The management should strive hard to improve its services to meet the need and aspiration of the people. The staff of water works should check the activities of private plumbers who engage in illegal removal or connection of pipes, and any body caught should be treated as an economic saboteur.
7. Again more deep wells and bore-holes should be provided at strategic point in the villages around the town where pipe borne water supply did not reach them, so that the seasonality problem will reduce, if not completely eradicated.

REFERENCES

- ABDU, Y. (1998) Planning and Management for sustainable Urban Water Supply. Unpublished M.S. Thesis, Department of Urban and Regional Planning ABU Zaria
- ABUBAKAR, S.A. (2000) PGD Lectures note on "Environmental Monitoring and Assessment" FUT, Minna.
- ABUBAKAR U.F. (1996) "Waste Water Management in Keffi Town " Unpublished HND Project, Federal Polytechnic Nasarawa.
- ADENIYI E.O. (1975) The Kainji Dam, An Exercise in Regional Development Planning, Regional Studies Volume 10
- AKINTOLA, F.O. and AREOLA, O.O. (1980) Domestic Water Consumption in Urban Areas. A Case Study of Ibadan City, Nigeria Water Supply and Management Volume 4, pp313-321
- AKINYEYE, P.S. (2000) "Fresh Water Resources " PGD Lectures Notes FUT, Minna.
- AYOADE J.O. (1988) The Tropical Hydrology and Water Resources
- AYOADE, J.O. and OYEBANDE, L. (1978) "Water Resources " In A Geography Of Nigerian Development PP40-56
- CHOW/MAIDMENT (1988) Applied Hydrology
- FANIRAN, A. (1985) Conjunctive Water Use: A Strategy for Water Supply Design. Journal Of Institute of Town Planners, Volume iv and vi.
- FULANI, A. (1977) A Geography of Nigeria Development .
- HAMIDU, I.B (1988) Spatial Inequalities in Domestic Water in Yola Metropolis of Gongola State. Unpublished B.Sc Research Project Department of Geography ABU Zaria.
- HOGBEN, S.J. and KIRK-GREENE, A.H.M. (1966): Emirates of Northern Nigeria. A preliminary survey of their Historical Traditions pp129-133
- ISAC, O. (1968) Water Crisis in Nigeria Towns in Geographer and Planning.
- JENNIE EVANS (1991) "Safe Drinking Water for the Developing World"
- KIRK - GREENE, A.H.M (1920) "Founding of Keffi Emirate, A.D. 1802" Gazetteers of the Northern Provinces of Nigeria: Nasarawa Province pp 6-8
- MILER, W. and RUTH, E.B. (1968) Water Resources Journal, Volume No 2 pp 2- 4

MUHAMMAD, A.M.(1999) "The Colonial Subjugation and Resistance In Northern Nigeria "Unpublished NCE Project. Advance Teachers College Akwanga

MUSA, H.C. (1994) Ground Water Supplementation in Damaturu,

Yobe State of Nigeria. Unpublished M.Sc Thesis, Department of Water Resources Engineering, University of South London, Uk.

NEST (1999) "Water" Nigeria's Threatened Environment. PP 60-99

ODAFEN, A.E (2000) "Geography and Environment" PGD lectures note FUT MINNA

OLUWANDE, P.A (1983) A Guide of Tropical Environmental Health and Engineering.

OSIYI, D.S.(1996) "Public Utilities and Services" HND lectures notes Federal Polytechnic Nasarawa.

OYEBANDE, L. (1975) Water resources Problems in Africa. In African Environment: Problems and Prospects. International African Institute, High Holbon London.

SADA, P.O and ODEMERHO, F.O. (1988) Environmental Issues and Management in Nigeria Development.

STEEL, W. (1979) Water Supply and Severage, M.C. Graw-Hill International, Tokyo Japan.

SUNDAY CONCORD. (1983) "KEFFI: Its old and new faces.

In Concord Magazine, Sunday, 26 June, pp MAG I, v& xi

TEMPLE, O.(1965) Northern Nigeria Tribes and Emirates pp 506-512

ZAHRADEEN, A.U 91995) Some Aspects of Research Methodology In the Management Sciences.

APPENDIX

FEDERAL UNIVERSITY OF TECHNOLOGY MINNA
SCHOOL OF SCIENCE AND SCIENCE EDUCATION
DEPARTMENT OF GEOGRAPHY
POST GRADUATE DIPLOMA DISSERTATION

AN APPRAISAL OF KEFFI PORTABLE WATER SUPPLY PROJECT.
(CASE STUDY: KEFFI WATER WORKS)

QUESTIONNAIRE "A" WATER BOARD

NAME:.....

RANK:.....

WATER SUPPLY

1. When was the Board establish?
2. When did the Board start operation?
3. Before the establishment, which body or group or organization was responsible for the supply of water in the Local Government?
4. Before supply, which method(s) use in treating the available water (treatment technique)?
5. What are the problems associated with the treatment?
6. What do you do to ensure the problems does not occur?
7. How many reservoirs have you?
8. What is the capacity of each reservoir?
9. Does the reservoir's capacity enough to meet the requirement of the population?
10. For how long does the reservoir supply the town?
11. Is the supply being guided by demand for various uses in the town?
12. Is there any industry you supply water to? If any which type light or heavy industry?
13. Is the supply based on flat rate, metered or others? Specify
14. Is the board working with other organizations or agencies?
15. Is the board being guided by a supply master plan in distribution?

REVENUE GENERATION AND FUNDING

- 16 What is the board's source(s) of fund?
(a) State Government (b) Federal Government (c) Keffi Local Government (d) Foreign Aid
- 17 Now that we are in democracy government; sometimes political interference is one of the reasons for inadequate funding of the scheme, does this affect your board?
- 18 Do you have adequate fund to the board for operating the water supply system?
- 19 How much did Keffi water board alone generate as revenue last year?
- 20 What was the initial Government allocation to Keffi water board compared to those of other town?
- 21 What was the initial and present water bill per tap?
- 22 What is the consumers attitude to payment of water bill?
- 23 Is the board planning to increase water bill, if yes, why and how much?

SOURCE

- 24 From which sources did the board get it water? (ground water or surface water) and from which river?
- 25 Is the board considering developing a ground water source to complement the surface water source?
- 26 If yes, where and how feasible?

DISTRIBUTION

- 27 When was first distribution network installed in the town?
- 28 After treating water, do you directly distributed to the public or store it?
- 29 Which system use in the distribution of water ((a) Grarity system, (b)Distributive reservoir system, (c) Direct pressure system, (d) others specify)?
- 30 What number of litres of water distributed in a day?
- 31 How rampant is the problem of leakage?
- 32 How many functional stand-pipes are in different parts of the town and how many are they in total?
- 33 How many reservoirs have you in the town?

MANAGEMENT

- 34 what are the problems you are facing with the community?
- 35 What can you contribute to ensure that these problems does not occur?
- 36 The problems of spillage of water, illegal connection to the mains and vandalism of inadequate facilities are known to the management, why the management could not respond (Keffi water board)?
- 37 What are your achievement so far since inception?

QUESTIONNAIRE "B" HOUSE HOLD

1. House number.....DATE.....Ward.....
2. PERSONAL INFORMATION OF RESPONDENT
 - i) Age..... ii) occupation.....
 - iii) Sex..... Iv)Literacy level.....
 - iv) Town/state/country of origin...
 - v) Marital Status.....
3. Monthly income.....
4. Which source(s) of water do you rely on for your water supply?
(I) well..... (ii) spring..... (iii) public stand-pipe.....
(iv) water vendor.....(v) other specify.....
5. Is your source of water from tap? Yes..... No.....
if tap specify, Public tap..... Private tap.....
6. If public water supply, which of the following do you use?.....
 - (a) Public stand-pipe ()
 - (b) Private house-connections ()
 - (c) Water vendor ()
 - (d) Public open concrete ()
7. How much do you pay as water rate?.....
8. How much water do you use for the following household activities in litres?.....
 - (a) Cooking/drinking.....
 - (b) Laundry.....
 - (c) Washing/personal hygiene.....
 - (d) Others (Ablutions).....
9. Do you think water supply is enough in the town?.....

10. Is the water good enough for human consumption? Yes.....No.....
11. How much do you spend on water vendors every day?.....
12. In case water supply improves, will you be ready to agree to pay increased water bill?.....
13. If yes, how much?.....
14. Is the supply from stand-pipes sufficient?.....
15. How in your opinion do you think Government can improve water supply in Keffi?.....