SPATIAL VARIATIONS IN QUALITY AND QUANTITY OF PUBLIC WATER SUPPLY IN BIDA TOWN NIGER STATE

BY

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CERTIFICATION

This project work has been read and certified by the undersigned as being met the requirement for the award of the Post Graduate Diploma (PGD) certificate in Environmental Management of Federal University of Technology, Minna.

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DEDICATION

To my caring parents (Alhaji and Hajiya Iliyasu Bida) wonderful sister (Hajiya Sagi S. Ndayako) loving and caring wife (Mallama Hauwa S. S.).

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`I acknowledged the enmass contribution of so many people that touch my life during the course of studies, notably and foremost, are departmental lecturers the likes of: -

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Special regards to my immediate and extended family.

DECLARATION

I hereby declare that except where literature is cited the investigation carried out on this study and the results obtained are purely my effort and not a duplication of another person's work previously done anywhere.

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ABSTRACT

This project work examines the problems of spatial variations in quality and quantity of public water supply in Bida municipality. Using stratified random sampling techniques; River Gbako water sampling point 505 residential units were selected for the study. The water samples were subjected to laboratory analyses to determine variation in terms of quality when compared to World Health Organization recommended values. The survey on residential unit to determine variations in quantity was done using structured questionnaires.

The laboratory analyses and social survey indicated low quality, inadequate supply, unsteady supply and in adequate spatial distribution of water supply in the town. The treatment of water at source, the maintenance of supply lines and the choice of good borehole sites are recommended as measures capable of improving the quality of supply. A more disaggregated statistical techniques based on determining the needs of all users and other demand factors has been recommended for application to determine present and future water demands, a means which it is hoped will solve the problem of spatial variation and inadequacy in quantity of supply.

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CHAPTER ONE

1.0. INTRODUCTION

Water is a social and economic necessity, without water, no economic endeavour is possible. This remark emphasizes, the importance of water in the economic development of any area. Conservely, negative aspects of water signify adversity. It's total absence; inadequacy or poor quality has a direct effect on the health of the people. Thus, water has both social and economic importance and is founded on this pretext.

The water demand of a specific community is satisfied by balancing the quality and quantity of the natural supply using storage reservoirs, treatment works control and delivering the potable water to the point of demand by a water distribution system.

In domestic water supply planning, the water planners and Engineers look at the amount of water that is to be provided daily per person / household. Technically speaking this is the pivoting point on which the entire design stands. At the same time specifying the required level of service is a difficult task, which involves numerous determinants. The problem is complicated because water is a valuable natural resource, which is getting increasingly scarce. Wise and efficient management of this resource is essential.

Babbit et, al (1962); fair et, al (1966), Textbooks on water supply have noted several factors which may effect municipal water use. These include; the size of the community, it's location, the standard of living, distribution system; pressure, water quality, water pricing, the existence of sewers, the percentage of water services preferred, the climatic and the system's management.

Water use varies from city to city, depending on the climate, characteristics of the environmental concern, population, industrialization, and other factors. In a given city, water use also varies from season to season, day to day, and hour to hour. Thus, in the planning of a water supply system, the probable water use and its variations must be estimated as accurately as possible. George et al (1974).

In practical terms these are only few of the many variables, which have some influence on water use.

1.1. PREVIEW OF WATER SUPPLY SCHEME IN NIGERIA TO DATE.

During the pre – independence era in Nigeria, water supply had been an human and animal carriage from rivers, streams, ponds, springs and wells.

The first known recorded water impoundment for Agricultural purposes in Nigeria was that of the flood from Sokoto and Rima valley about 1918. The project was as a result of the studies of Conel Collin and the flood of 1922 destroyed the project. Dugwells, however dates back to settlements many of which dried – up in the dry seasons. While the commercial city of Kano is about one thousand years old, organized water supply started around 1928 by the colonial administrators using tube wells along the beds of River Challawa.

The hydrological studies that commenced in 1963 after the independence resulted in the construction of Earth dams. Generally, between 1900 and 1940 available water scheme were designed and constructed to supply hospitals and government establishments in the large cities for example, the G. R. A water supply in Akure (Ondo State) has been in existence since 1940. However, as far back as 1960, the government of the defunct Western Region of Nigeria became convinced of the necessity for adequate management of the water supply scheme that had been established by the ministry of works and transport between 1950 and 1960, but which were in – adequately manage by the local government to which the scheme were handed over.

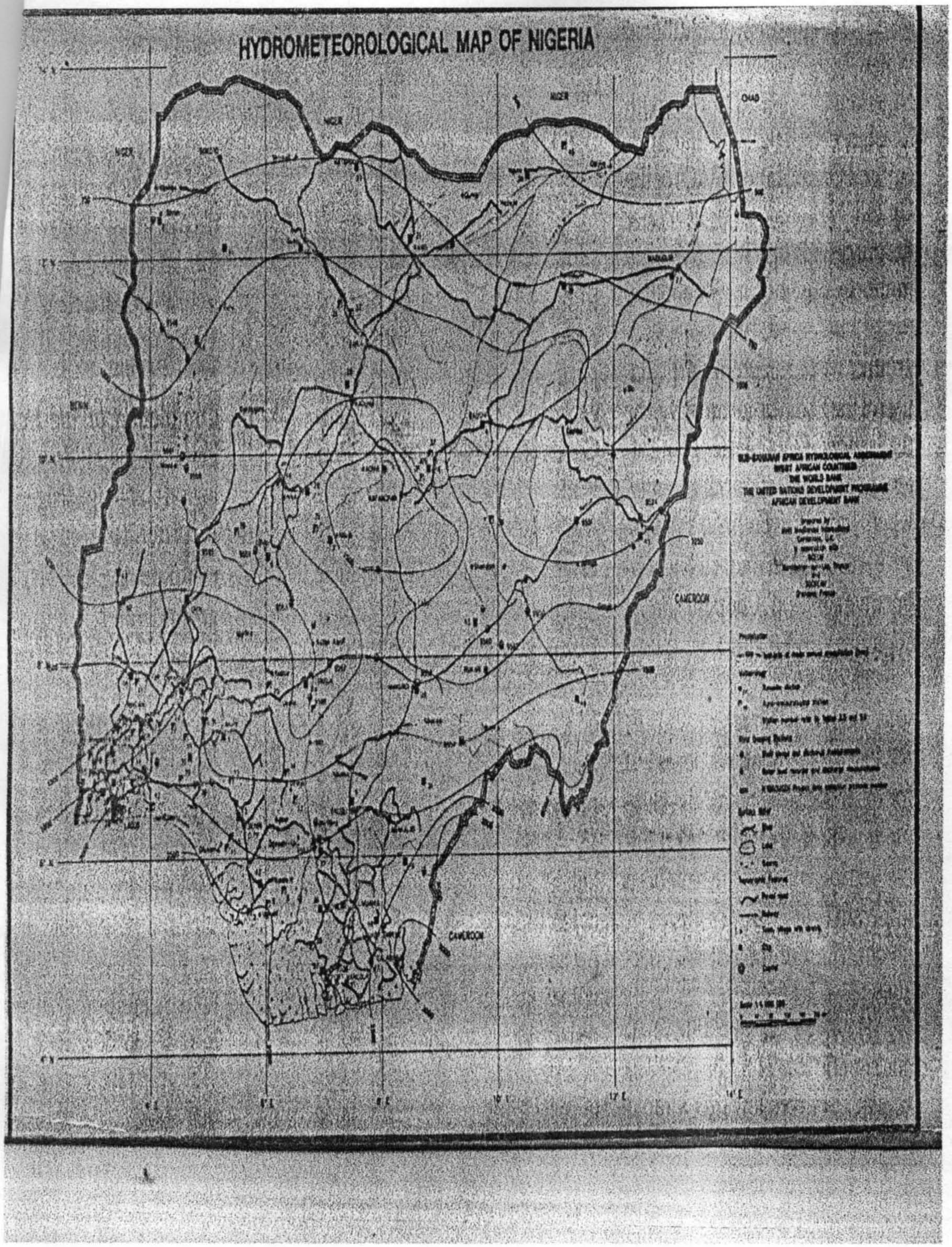
The Western Nigeria water corporation Law of 1964 was then enacted. At the drawing up of the second national development plan of 1970 – 1974 various government of the federation had the same view.

Later, between 1974 – 76 the water corporations were established to take over responsibility mostly to the rural Areas. However, it has been observed that the commitment of these governments towards these goals is not total and even the existing ones only partially operational due to recent rehabilitation work under – taken for proper and efficient management and for good services.

The federal government in 1980 responded in favour of the United Nation International Drinking Water Supply and Sanitation Decade (1981 – 1990) – through series of campaigns. The major goals of this intervention implies the provision of potable water for all. The implication here was that every individual will have at his / her disposal 120 lpd (litres per day).

Also on December 6th – 9th 1993 an international workshop on preparation of the "National Water Resources on Master Plan for Nigeria" was discussed. The workshop was sponsored by the United Nation development Programme (UNDP), Food and Agricultural Organization (FAO) and World Bank. Speaking at the workshop, the then minister for water resource, Alhaji Isah Mohammed state's that "The preparation of a National Water Resource Master Plan for the country was initiated in 1984 with assistance from the food and Agricultural Organization (FAO) of the United Nation". Though the realization of this master plan came up only, when Japanese Technical Assistance was secured under a Nigeria – Japan Technical Co-operation. The objectives of the Nigeria water resources master plan is to prepare a comprehensive and up – to – date plan for maximum development and use of the water and related land resources of the country. It is to provide financial and economically sound investment options in water resource development to achieve accelerated and sustained growth in Agricultural production and to ensure efficient and sufficient potable water delivery. It is stated that the plan will cover the period up to the 2000 as short term and on the long term up to the year 2020 to provide appropriate development alternatives.

IG. 1.1. SHOWS HYDROMETEOROLOGICAL MAP OF NIGERIA.



1.2. STATEMENTS OF THE PROBLEM

Bida with an urban population of about 102,070 (1991 census) is one of the largest towns in Niger State of Nigeria.

The main source of water is from River Gbako water is supplied through pipelines to individual households and also standpipe located in strategic positions throughout the town.

However, despite the fact that the town is large in population and commerce in the state, potable water has been a problem for both domestic and industrial use. Certain percentage of population are experiencing water shortage for the past few years. While for the rest of the population the quantity and quality of water supplied is not enough.

Since it is imperative that the population be supplied with fresh water for the survival and well being of the people, at this 21st century, the problem of water in both quality and quantity is not adequate. The entire water works lack a quality control laboratory.

The serous problems associated with the water supply in Bida motivated this study; it is therefore hope that the study will provide a lasting solution for the benefit and welfare of the populace

1.3. OBJECTIVE OF THE STUDY.

The objective of this project work is to assess the water supply scheme available in Bida. It is aimed at making the best use of the existing resources and looking into some other alternatives for obtaining new ones. Suggestions can equally be carried out promptly to remedy problems in the existing water supply scheme in the study area. Furthermore objectives of these work includes:

i. Accessing the degree of service of a complete water supply schemes to determine its suitability, adequacy and recommend a suitable improvement to the government.

ii. To provide a feedback on the appropriateness of some of the supplementary sources and how they can be improved to ad in reducing the problems of water shortage.

iii. To justify the effort being made by government with a view to attract further resources.

1.4. SCOPE AND LIMITATION

The scope of the work to be carried out in this project includes:

(i). Research work intended to cover the entire water supply scheme in Bida. A detail technical survey of the scheme in order to describe and access their functioning and efficiency.

(ii). Recognizance survey and interview on some of the supplementary sources with a view to recommend possible ways to improve them. The project limitation includes surface water source exploration survey.

Pneumatic operated / hand pump borehole as well as hand dug wells are to be look into in the source of this studies.

1.5. DESCRIPTION OF THE STUDY AREA

Bida is the traditional headquarters of the Nupes and an administrative headquarters of Bida Local Government Area, and also Bida Emirate in Niger State.

1.6. GEOGRAPHICAL LOCATION AND CLIMATE

Bida is located on latitude $9^0$06'N and longitude $6^0$01'E. It is on the Nupe sand stone formation, located 19km North of the River Kaduna along Mokwa / Bida road and 161km south east of Minna, the Niger State capital, the town is situated in a valley by the Chiken and Mussa stream tributaries of Gbako River. A third stream Landzun stream bisects the town.

Bida experience district dry and wet season between April / May and October, the wet season lasts for about 200 days. Average rainfall is 1227mm with July and September recordings the peak rainfall of 226.3 and 248.8mm respectively. The mean monthly temperature is highest in March at 31.1^{0}C and lowest in August at 26^{0}C. Bida is thus blessed with moderate climatic condition throughout the year.

1.7. ECONOMY

Agricultultural is the main stay of Bida economy. The crops grown include guinea corn, rice, millet, sweet potatoes and sugarcane. The landzun, chiken and mussa streams provide good irrigation facilities for the farmers. It is noteworthy that the former Bida Agricultural Development project which covers the five local government of Gbako, Lavun, Agaie, Katcha and Lapai has it headquarters in Bida town along Bida / Minna road.

1.7.1. LAND USE: - AGRICULTURAL

(a). **ARABLE FARMING:** - There exist general farmland, which could be sub divided into commercial and individual, or private farming system.

Major investments have been made in large scale commercial farms around the Bida urban development Area. Gbakogi maize farm own by Nigerian Breweries produces 100metric tonnes of maize seedling every year, also large-scale B.C.C.C. farm south of Wuya road produce 100metric tonnes of cassava. While small scale farming mostly operated by individuals applied the best method of traditional mixed – crop within the urban fence of the town.

(b). **POULTRY:** - A poultry demostration and holding unit (3.3ha) exists at Bazumagi Ndatoaki on the Badeggi road. Also commercial poultry farms are located in the proposed commercial – residential Areas along the Zungeru road. Other small scale mostly own by private, individual also operate at home.

(c). **CATTLE REARING**: - Cattle rearing is striving in and around Bida, there are mostly own by Bida individual who employed the services of Fulani people to work for them, it is estimated that about 35 – 50,000 head of cattle could be found in the town.

1.7.2 CLIMATIC CONDITION

The climatic condition of the Area (Bida) is essentially the same as typical of the middle belt of Nigeria with high temperature and excessive humidity during the most part of the year. This is based on records. Available from National Cereal Research Institute Badeggi.

(a). **RAINFALL:** - The normal annual rainfall ranges between 1100mm and 1200mm. Rainfall normally occurs between the months of April to October. The peak rainfall is recorded during the month of August. Recorded data of monthly rainfall (mm) for a period of 10 years (i.e) 1990 – 2000 obtained from National Cereal Research Institute Badeggi is show in Table 1.1.

(b). **TEMPERATURE**: - Bida is a town of contrasts with a compact and crowded core, as earlier mention the climatic condition of the Area (Bida) is essentially the same as typical of the middle belt of Nigeria with high temperature and excessive humidity during the most part of the year. The mean monthly temperature is highest in March at 31.1^0C and lowest in August at 26.0^0C.

(c). **RELATIVE HUMIDITY**: - Humidity is generally high throughout the year and varies from a minimum of 51% to maximum of 87% as obtained from National Cereals Research Institute (N.C. R.I) Badeggi.

TABLE 1.1:

YEAR	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
1990	0.0	4.3	0.0	81.8	287.3	117.9	266.0	180.6	160.0	110.1	2.7	0.0	1210.7
1991	0.0	0.5	68.3	50.8	205.9	331.5	237.0	244.7	149.6	75.1	0.0	0.0	1363.4
1992	0.0	0.0	0.0	411.7	136.6	133.9	128.6	148.4	216.0	31.5	0.0	0.0	936.7
1993	0.0	0.0	61.6	8.9	154.7	241.8	206.8	308.4	240.4	152.8	0.0	0.0	1375.4
1994	0.0	0.0	0.0	38.9	171.9	151.4	75.8	425.7	194.0	102.1	0.0	0.0	1159.8
1995	0.0	0.0	22.9	43.8	92.3	128.7	236.7	307.5	152.2	105.6	12.3	0.0	1102
1996	0.0	18.9	0.0	12.6	199.9	190.7	201.8	326.1	170.5	41.3	0.0	0.0	1161.8
1997	0.0	0.0	64.9	53.9	129.3	279.2	219.0	227.2	147.5	135.4	7.2	0.0	1263.6
1998	0.0	0.0	0.0	67.1	213.2	75.5	239.7	145.5	153.7	103.0	0.0	0.0	997.7
1999	0.0	2.8	0.8	112.1	135.4	196.8	264.1	194.5	153.7	98.0	0.0	0.0	1158.2
2000	0.0	0.0	0.0	64.7	172.3	231.8	236.7	307.6	194.2	123.1	4.1	0.0	1334.5
AVERAGE	0.0	2.41	19.86	61.48	172.61	189.02	210.2	226.02	175.62	98	2.39	0.0	1157.61

SOURCE: N. C. R. I BADEGGI

1.7. EXISTING FACILITIES

Initially water from the source was supplied from Badeggi (a village near Bida) for both Bida and Badeggi after being pump from the river for treatment at a water works nearby. The rated output of this water works is 3,410m^3 / day (0.75mgd). it still continue to be used but only to supply Badeggi and Army Barracks along Badeggi road. The original pump and structure now cease to function and have been replaced by a less satisfactory arrangement of an unprotected potable pump on the riverbank adjacent to it.

A new water works located further down stream and known as MANA water treatment works was build by MESSIERS COSTAIN and commissioned in February 1978. It has a capacity of 13,600m^3 / day (3mgd) and is required to supply Bida alone. The design was based on the estimated population of 76,000 people (census 1962) for Bida so that the treatment water works capacity of 13,600m^3 / day provides for a demand rate of 179l/dd.

The water works was improved to the current supply situation. The average demand has risen to 37,400m^3. The treatment capacity has also increase to 45,000m^3/ day.

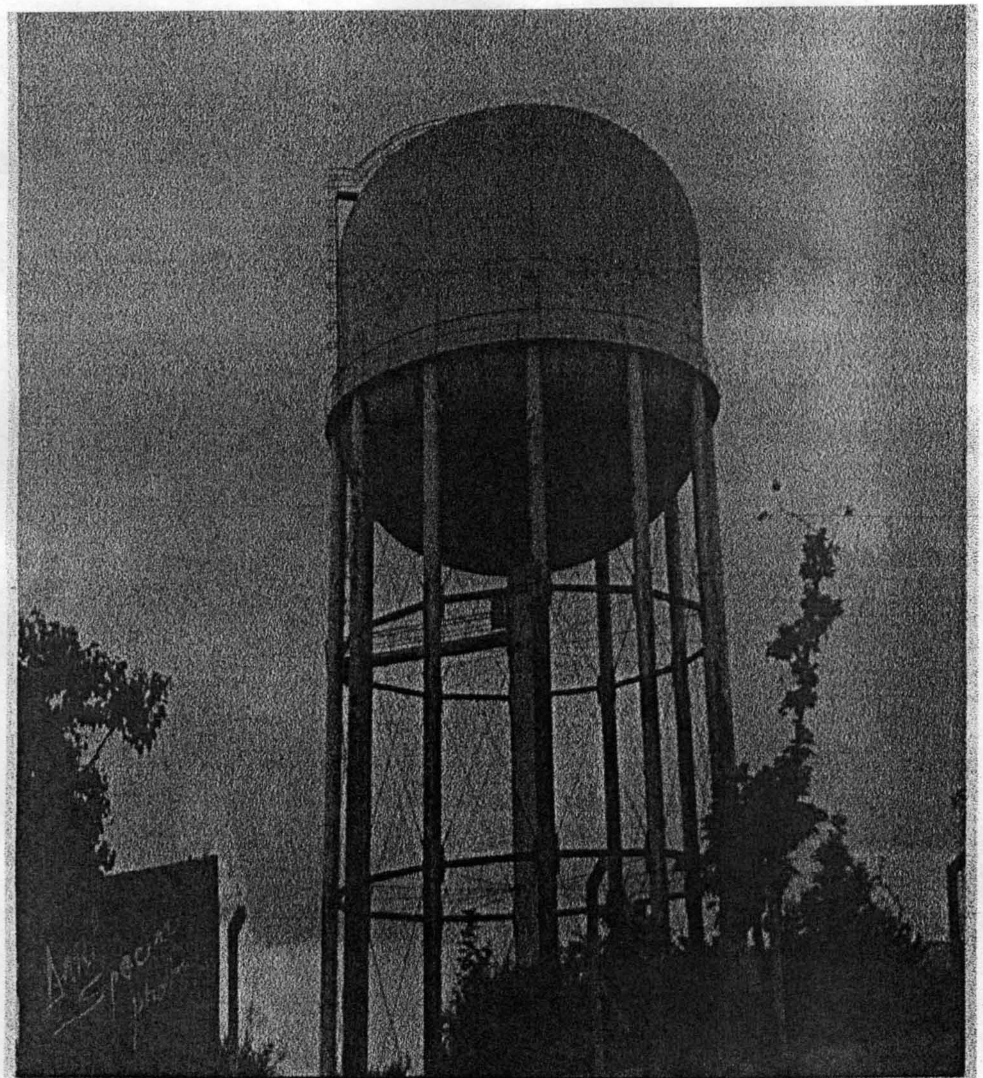
The existing supply at MANA consists of a pumping station intake on the right bank of the Gbako River. It houses four vertical centrifugal pumps in a dry/wet well structure, each capable of delivering 340m^3/hr (75,000g/hr) to the treatment water works nearby. The operational policy is to extract and treat in accordance with maintaining desirable water level in the clear water reservoir. When the demand is high his sometimes requires at least two pumps pumping together. The normal operation is to allow each pump to deliver water for treatment for a period of 6 hours, so that each pump works for 6hours in every 24hours.

Treatment is in the form of chemically assisted sedimentation using aluminium sulphate, followed by rapid gravity filtration, with filtered water passing through to a clear water reservoir at ground level having a capacity of 4,500m3. Chlorine is added by hand in the form of chloride of lime, after it leaves the filter. This is not a satisfactory method, as the control of chlorine concentration is difficult to achieve, provision does exist for chlorine gas injection but yet the system has not been installed.

The water works comprises of four sedimentation tanks and four filters, filter back wash pumps and three main pumps deliver the treated water through a 450mm diameter ductile iron rising main pipe to storage in Bida.

1.9. DISTRIBUTION SYSTEM

The distribution system consists of a network of pipes and service storage tanks serving the existing development. The principal storage is an elevated tank of 4,500m^3 (fig 1.2) with bottom tank of approximately 20m (70ft) above the ground level. It is located on the high ground about 3.3km. East from the centre of the town and about 1.2km south of Badeggi road. The original 900m^3 ground level tank also exists on the same site. The total elevated storage capacity therefore is of the order to 5,4000m^3 representing approximately 24 hours total storage.

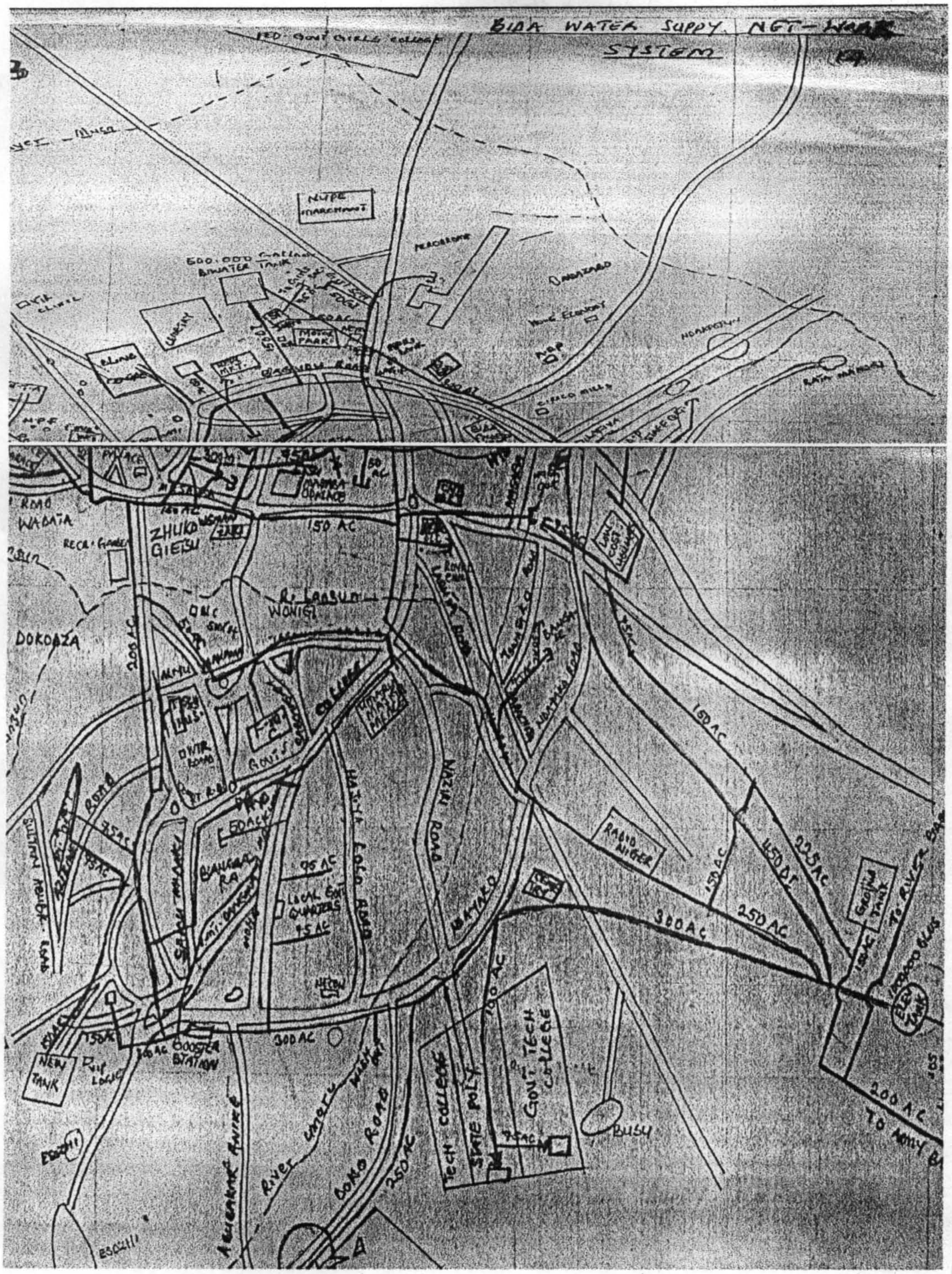


The figure 1.2. above shows, the principal storage elevated tank of 4,500m^3.

The water is lifted from the river from a level of approximately 67.4m to gravitate through the process units of treatment water works. The clear water is then pumped from a level of Approximately 82.8m to the top water level of the elevated tanks at approximately 210.4m through 8km of 450mm diameter ductile iron rising main pipe.

Figure 1.3. Shows water supply net – work system of the town (Bida).

Figure 1.3. Shows water supply net – work system of the town (Bida).



source: WATER BOARD BIDA.

1.9.1. STRUCTURE OF THE PROJECT.

Chapter one deals specifically with the introductory aspect of the project, while chapter two emphasizes on the literature review, in chapter three, the methodology by which whole project is carried out. Chapter four spelt out the result or analysis of the project. While finally chapter five brings us to conclusion / recommendation. References follow immediately.

CHAPTER TWO

2.0. LITERATURE REVIEW

2.1. THE DEVELOPMENT OF WATER SUPPLY

The history of water supply begins with the growth of ancient capital cities; this is strongly in line with the recent development of present day water supply, which is as ancient as the history of man.

In ancient times water supply stopped when the sky gave no rain and springs, streams dried up. Ruins of cities that died out because of failing water supply can be found in the Middle East and in parts of the southwestern United States. Tailor (2000).

Primitive man lived near springs, rivers and lakes because he had only the crudest vessels for handling and storing water. One of civilization greatest advances took place when man discovered various ways of getting water by artificial means with, this discoveries, he no longer had to leave close to its natural suppliers.

The first system of artificial water supply was probably the taking of water from the ground by means of a well. Then limitating the rivers of nature, man caused water to flow through ditches and later through pipelines, clams and reserviours (place where water is collected and stored until needed).

Roman – aqueducts – canals through which water can be brought from distant reservoirs and lakes still survive, proving the remarkable vastness of early man made water works. The yields from such sources were conveyed to the cities by means of aqueducts. Separate pipes, were connected to another three sub – reservoirs from which water was supplied and then passes through the receptacles to the various useable points.

Water dominates our history. The ancient Egyptians constructed an extensive system of reservoirs, storing – up the waters of the Nile. There are many references to water supply in the Bida for example, the 26th chapter of Genesis tells how Isaac's herdsmen fought with the inhabitants of the valley of Gerar for the possession of wells in the valley. Much later king Hezekiah "made a pool and conduit and brought water into the city of Jerusalem (II kings: 20, 20).

Ancient Rome probably would never have attained it's greatness without the assistance of its water works engineers. The waters of the Tiber had become too polluted to serve for drinking purposes. The Engineers constructed nearly 650kilometers of aqueducts, which brought water into the city from various outsides sources. In Arizona and New Mexico, archaeologist still explores irrigation projects build by ancient North – American Indian Engineers. Foster (1979).

At the beginning of Nineteenth century in Britain under the reign of George III, the population was then 10.5 million and although the industrial revolution had started, some fifty years previously there were practically no pipe supply of water. But the passage of the next one and half century, however, was to show a remarkable changes, under the reign of Elizabeth II when the population had risen to 52.5million, every town and early large villages has a constant piped supply of potable water.

Verily, these achievements are made with the coming of hydraulic machinery for bringing water from great depths, as did the invention of pump dating back to about 1915, for driving water through miles of pipelines. Modern technology can furnish water in huge quantities. Strangely, however, no Nation is entirely free of the possibility of a water supply shortage, vehicle et al (1913).

CHAPTER THREE

3.0. METHODOLOGY

The most important aim of technical evaluation is to investigate the extent and causes of water shortage and the qualities of elemental and physical properties of water in the Study Area.

The research techniques employed in the study area are:-

(i). Analyses of water sample to ascertain spatial variations in quality.

(ii). Questionnaire survey.

(iii). Informal interview.

(iv). Physical measure and direct observation.

These techniques were employed to provide information on the spatial variation on the quality and quantity of water supply to the Study Area.

3.1. (i) ANALYSES OF WATER SAMPLE TO ASCERTAIN SPATIAL VARIATIONS IN QUALITY.

To ascertain spatial variation in the quality aspect of water supply, water samples was collected from sampling point (i.e.) River Gbako and analyzed.

Gallenkamp flames Analyser and Atomic absorption spetrophotometer (model PYE UNICAM SP 2900) were used in the analyses of elemental and physical properties of water. Appearance of the water samples was determined by observation with the naked eye.

The values obtained in the above analyses were compared with the World Health Organization (W.H.O) standard values to determined deviations (positive or negative) from the standard and thus spatial variations in quality of water supply in the municipality.

3.2. (ii). QUESTIONNAIRE SURVEY

A survey questionnaire (see Appendix A) was conducted on 505 households sampled from the 14 wards of the town. The questionnaire was administered in the presence of other household members provided an opportunity to confirm the accuracy of information provided by the respondents. Stratified random sampling method was used in determining the approximate numbers of household involve in the survey.

3.3. (Iii). INFORMAL INTERVIEW

Informal interview was adopted in retrieving data on number of supply schemes of various Areas; this was administered concurrently with the survey questionnaire conducted with some key household informants.

3.4. (iv). PHYSICAL MEASURE AND DIRECT OBSERVATION

During the survey questionnaire, household activities related to water demand, water fetching and supply, water storage and wage, especially, the allocation of water to various domestic activities were observed directly and recorded, in other to obtain quantitative data required for the estimation of water use.

The use of statistical methods will be employed for data analysis. Since such method include the use of percentage (%) mean, graph etc.

3.5. DETERMINING DOMESTIC WATER DEMAND

Forecasting for domestic demand is the product of two other forecast; those of population and of per capita consumption, the latter either volume used per person population or volume used per household number of households.

Population forecasting is easy. Forecasting per capita demand is the more difficult of the two. Previous studies have sought to develop time series and multiple regression models for forecasting per capita demand (e.g. Batchelor 1975; thrackray et al (1981).

Archibalds (1983) disaggregated method relies on forecasting all components that make up domestic demand. These include variable such as present and future levels of ownership of appliances and fittings, the frequency of use, the volume of water per use and the proportion of population using those appliances and fittings. For bathing and showering components alone of the domestic per capita demand.

Archibald (1983) developed forecasting model viz:

BS =Ps (Vs. Fs + Vb. Fbs) + (1 – Ps) Vb. Fb

Where: -

BS = The volume used per person per day for bathing and showering;

Ps = The proportion of households with a shower;

Vs = The volume per shower;

Fs = Frequency of showering;

Fbs = Frequency of bathing in households with a bath and shower;

Vb = The volume per bath

Fb = The frequency of bathing in household with a bath only;

fs, fbs and fb vary with household size. In this way, forecasting could be done for other main components such as car washing, gardening, toilet flushing, waste disposal unit, dish and clothes washing and miscellaneous.

CHAPTER FOUR

4.0. ANALYSIS OF RESULT

4.1. PRESENT WATER QUALITY

The detailed analysis of water discharge from the treatment plant to the consumers shown that most of the parameters investigated were about the same value with those of W. H. O drinking water standards. Table 4.2. Shows the W. H. O guidelines for drinking quality. Table 4.1 Shows the detailed analysis of various parameters determined obtain from Department of microbiology, The Federal Polytechnic, Bida.

From the results of the water analysis of the present water supply it showed that the pH value of the sample used range from (7.4 – 7.6) which means that the values are within the range of W.H. O recommended level of (6.5 – 8.5).

The refractive index of all the potable water samples fell within the WHO value, which is 1.3312. so also the turbidility level of all the sample is 0.00 which means that all the samples are potable, with respect to turbidity.

All the samples are odourless, tasteless and colourless, which show that all the samples are potable when compared with WHO recommended standards for drinking water.

The chloride level of the sample is far below the WHO recommended level of 250ppm. And the hardness as CaCo3 level of water samples compared to (WHO) standard level showed that it is soft.

ANALYSIS ANDRESULT OF DIFFERENT SAMPLES

The below shows the result of of various parameters determined.

Table 4.1. Concentration of parameters in the sample.

S/No	Location	Temp. ^0C	Colour TCU	Turbidity NTU	Iron Mg/L	Chlorine Mg/L	Fluorine Mg/L	pH	Taste	Nitrate Mg/L	Sulp hate Mg/L	Manga nese Mg/L	Hard ness Mg/L	condu ctvity PPM
1	Zukogi Masaba	19	2.0	1.0	0.06	17	0.08	7.5	0.00	0.06	9.00	0.2	28	780
2	Federal Poly.	30.0	0.0	0.0	0.11	20	0.05	6.5	1.00	0.06	22.00	0.0	12	820
3	Umaru Majigi	30.1	2.0	0.0	0.09	13	0.03	7.5	0.00	0.04	19.00	0.1	32	920
4	Dokodza	31	1.0	1.0	0.05	15	0.04	7.5	0.00	0.05	10.00	0.2	30	810

SOURCE: DEPARTMENT OF CHEMICAL ENGINEERING, FEDERAL POLYTECHNIC BIDA.

4.2. WATER QUALITY CRITERIA

Table 4.2: WHO guidelines for Drinking water Quality

PARAMETER	UNIT	GUIDELINE VALUE
MICROBIOLOGICAL	QUALITY	
Faecal Coliforms	Number / 100Ml	Zero*
Coliform Organisms	Number / 100mL	Zero*
INORGANIC	CONSTITUENTS	
Arsenic	Mg/L	0.05
Cadmium	Mg/L	0.005
Chromium	Mg/L	0.05
Cyanide	Mg/L	0.1
Fluorine	Mg/L	1.5
Lead	Mg/L	0.05
Mercury	Mg/L	0.001
Nitrate	Mg/L (N)	10
Selenium	Mg/L	0.01
AESTHETIC QUALITY		
Aluminium	Mg/L	0.2
Chloride	Mg/L	250
Colour	TCU	15
Copper	Mg/L	1.0
Hardness	Mg/L (as $CaC0_3$	500
Iron	Mg/L	0.3
Manganese	Mg/L	0.3
PH		6.5 to 8.5
Sodium	Mg/L	200
Solids (total dissolved)	Mg/L	1000
Sulphate	Mg/L	400
TASTE AND ODOUR		Inoffensive to most consumers
Turbidity	NTU	5
Zinc	Mg/L	5.0

Source: WHO: 1984a

Treated water entering the distribution system.

4.3. QUALITY VARIATIONS

Although slight variations were noticed in all other aspects of the analyses, only two properties; - those of pH and iron (fe) were selected to demonstrate the degree of variations (positive and negative) from the World Health Organizations

(WHO) recommended standard values, for example in drinking water. Table 4.2 and Figure 4.1 as demonstration of these variations.

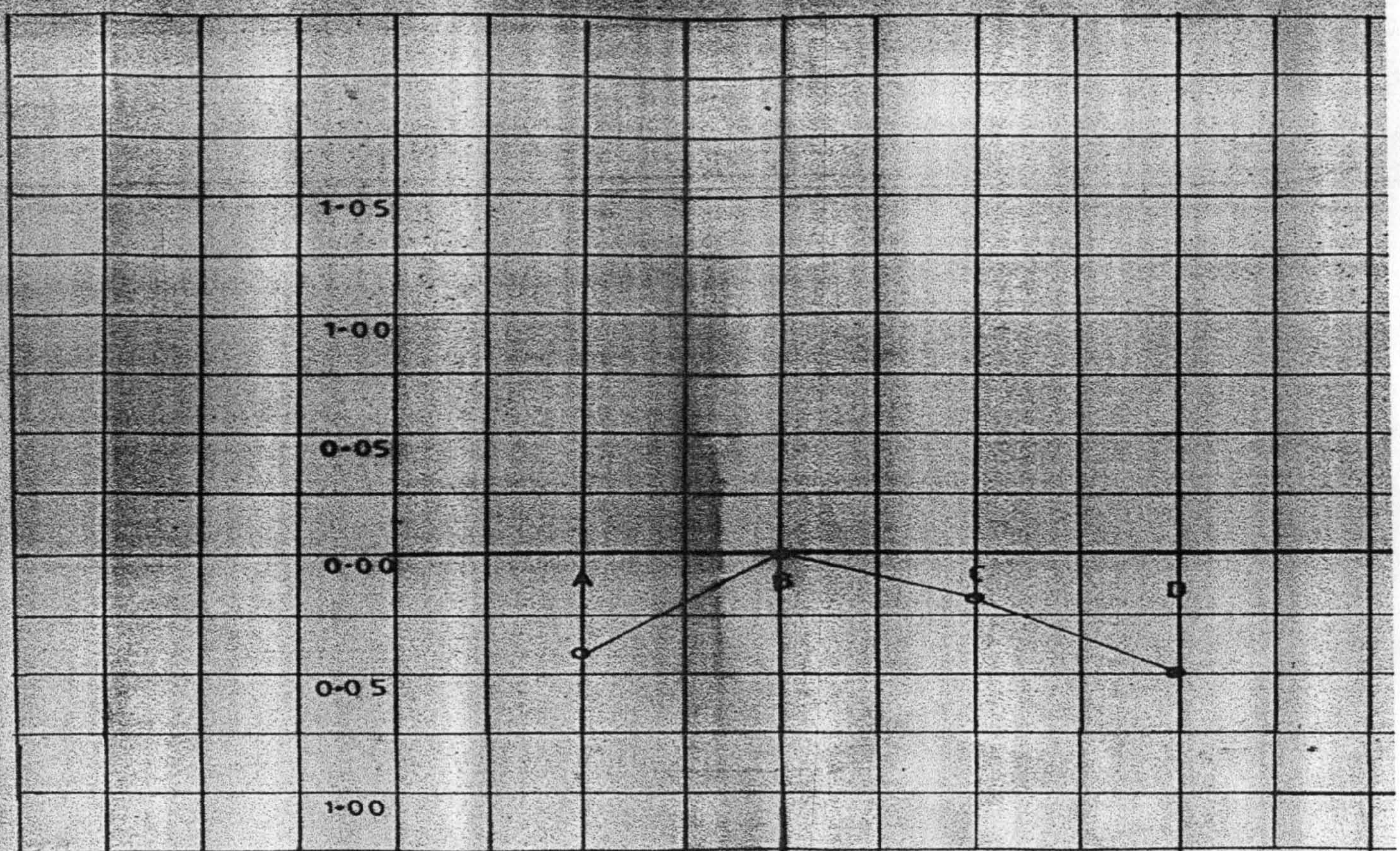
Table 4.3

		PH values WHO (6.5 – 8.5)		Fe levels in (PPM) WHO (0.10 – 1.00	
Source	Area	Sample Value	Deviation	Sample Values	Deviations
RIVER GBAKO	Zukogi A Masaba	7.5	1	0.06	-0.04
	Federal B Poly	6.5	0	0.11	N
	Umaru C Majigi	7.5	1	0.09	-0.01
	Dokodza D	7.5	1	0.05	-0.05

NOTE: in the column labeled deviation, + indicates higher deviation and – lower deviation from the World Health Organisation (WHO) recommended ranges; for pH: - = acidic and + = alkaline tendencies; for fe, - = less iron and + = excessive iron; no deviation.

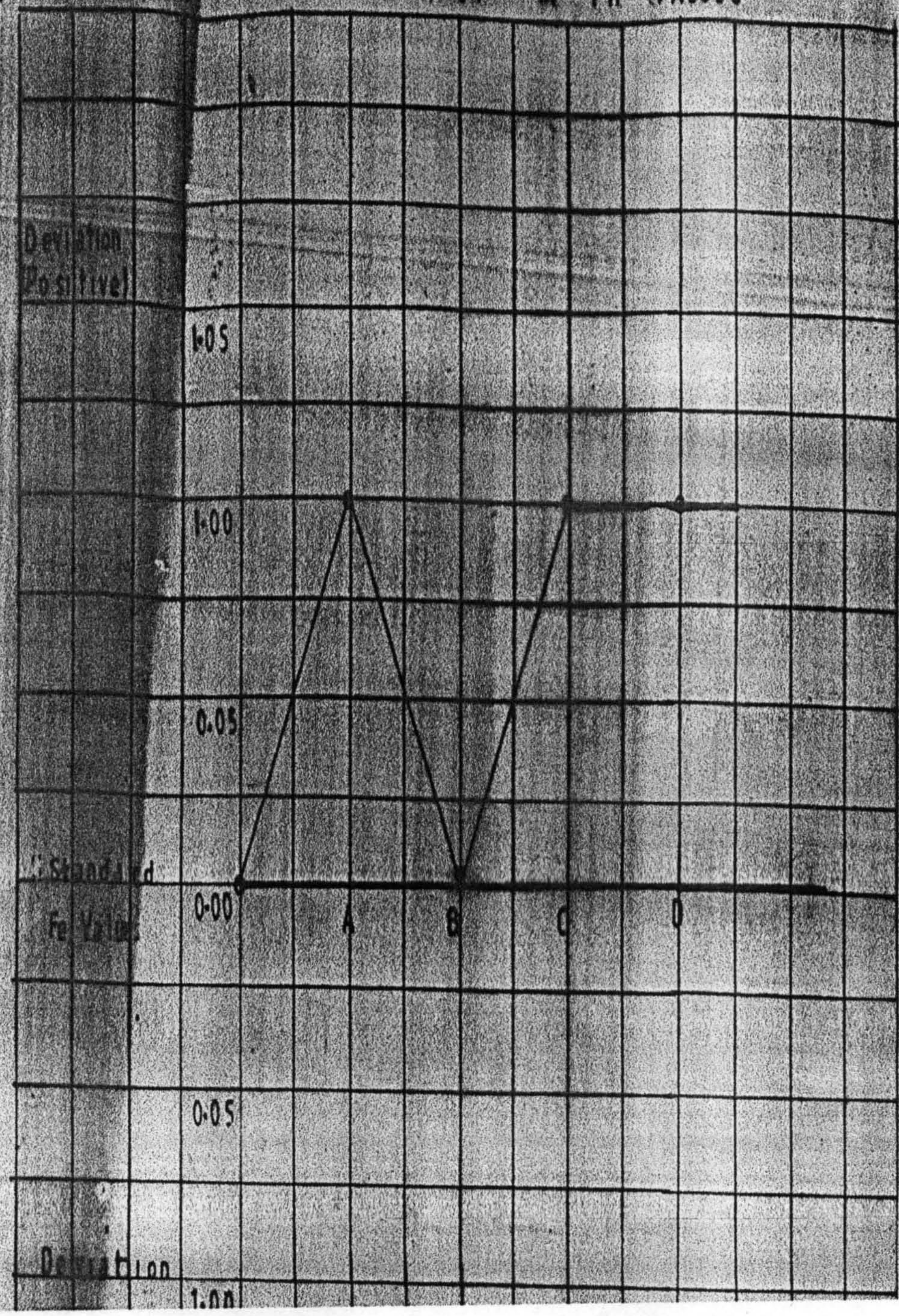
Source: Compiled by the author.

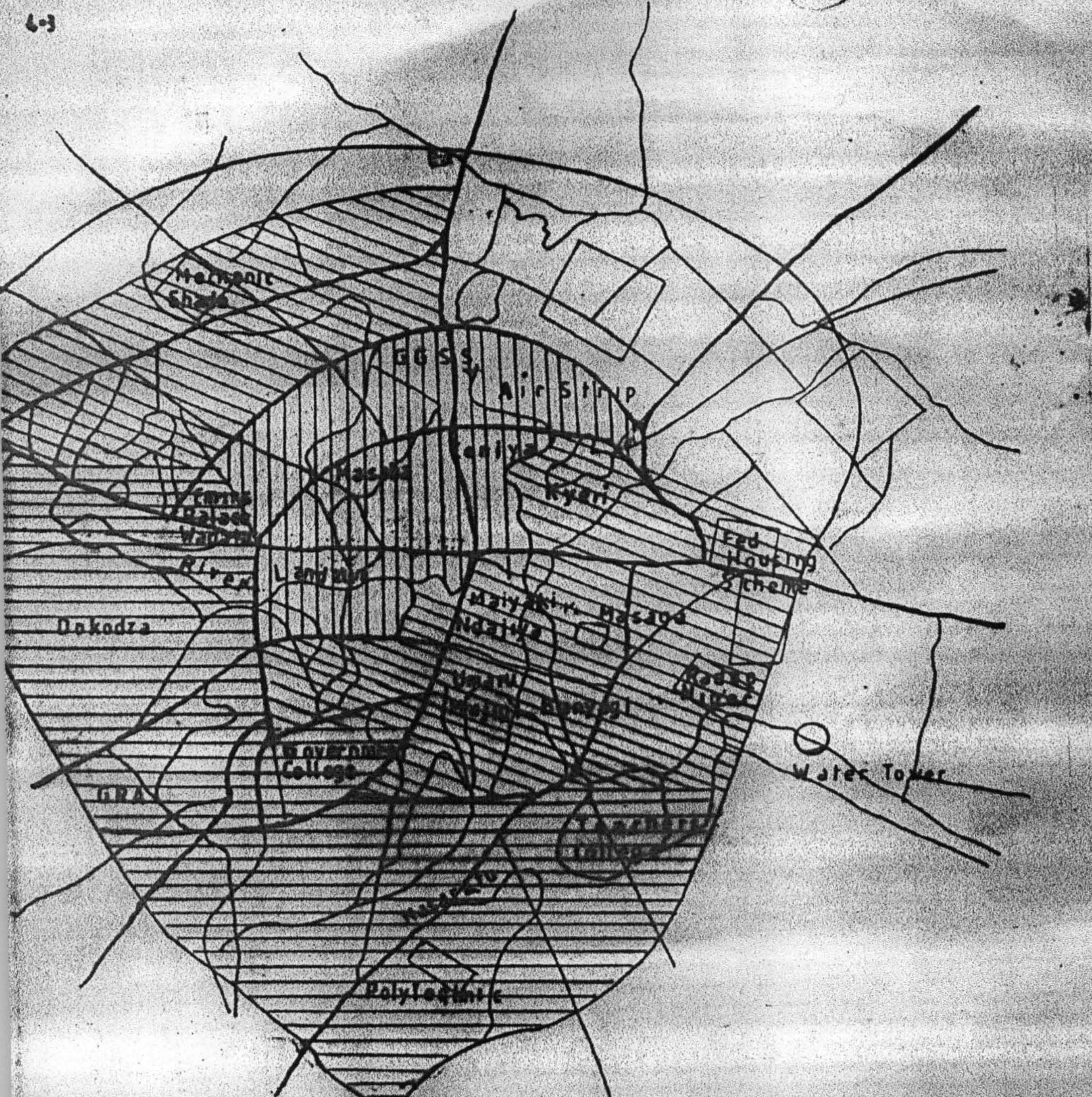
FIG [illegible] SHOWING VARIATION IN FE VALUES



SOURCE :- (DRAWN BY THE AUTHOR

FIG 4: SHOWING VARIATION IN PH VALUES





MAP OF BIDA SHOWING RESIDENTIAL ZONES CATEGORISATION FOR WATER SUPPLY

SOURCE: (BY THE AUTHOR)

Zones of Constant Supply (No Cuts)

Zones of Intermittent (Weekly, Monthly Cuts)

Zones of Uncertainty (Daily Cuts)

4.4. WATER USE ALLOCATION

The main categories of daily water use in Bida town are cooking, drinking, washing, bathing and cleaning of essential part of the body (Table 4.4) washing and bathing are the most water – intensive household use. 49 percent (49%) and 73 percent (73%) of household use 40or more litres of water per day for each of these activities. While 11 percent (11%) and 9percent (9%) use more than 60 litres of water per day for each of these activities. Ablution, which the Muslims perform of at last five times daily, consumes 3 litres per capital daily.

4.5. RESIDENTIAL WATER SUPPLY

The quantity of water supplied to each residential and commercial houses in Bida is not metered. Therefore, it was not possible to measure variation in quantity by way of actual volume supplied, to each household. However, it was possible to ascertain the regularity or irregularity of water supplied to household by way of response to structured questionnaire. It was believed that this was the nearest measurement to the variations in supply bearing in mind that household whose supply is regular is more likely to have greater supply in volume than that whose supply is irregular.

Accordingly, 505 household heads were interviewed on how regular or irregular water supply to their houses was. Where the response indicated irregularity in supply further questions probed into number of cuts in supply on a part time - period basis, say daily, weekly or monthly cuts see Table 4.5. The responses from the households were plotted into their respective residential zones. A definite pattern was observed in the overall analysis and the following zones emerged.

(i). Zones of constant supply (no cuts)

(ii). Zones of intermittent supply (weekly to monthly cuts) (iii). Zones of uncertainty (daily cuts) Table 4.6, Fig. 4.3 this indicates that although the entire Bida is officially supplied with water, variation occur in quantity supplied to the different areas, and not all residents in all parts of the town have equal access to the service.

Out of the 308 public outlet in the town only 103 are still functioning with only 21 having constant supply, 37 having daily cuts, 21 having weekly cuts and 24 having monthly cuts. Individuals in the areas maintain these public outlets or standpipes they are installed, but no fee's is paying Fig. 4.4 Table 4.8.

4.6. HAND PUMP BOREHOLE / DUG WELLS

The flow of ground water into the well and borehole is influenced by the physical characteristics of the water bearing formation.

The wells in the area of study are mostly hand – dug wells constructed by individual house owners in their respective premises, while some are builds outside for public uses to alleviate water shortage during the period of scarcity. About 10% to 15% of both borehole and wells inspected in some Areas are not of order while in some places 40% to 50%, though these are very – few areas. Appendix II.

However the yield of the hand-dug wells are poor especially during the dry season. The cause of some of the dilapidated ones has been traced as a result of improper construction and lack of good head works among others.

Consequently, tube wells, pneumatic operated boreholes are found to exist mostly in the residence of the wealthy people some extended pipes into overhead tanks, which serve the public through a tap head. See Figure 4.4 Table 4.7.

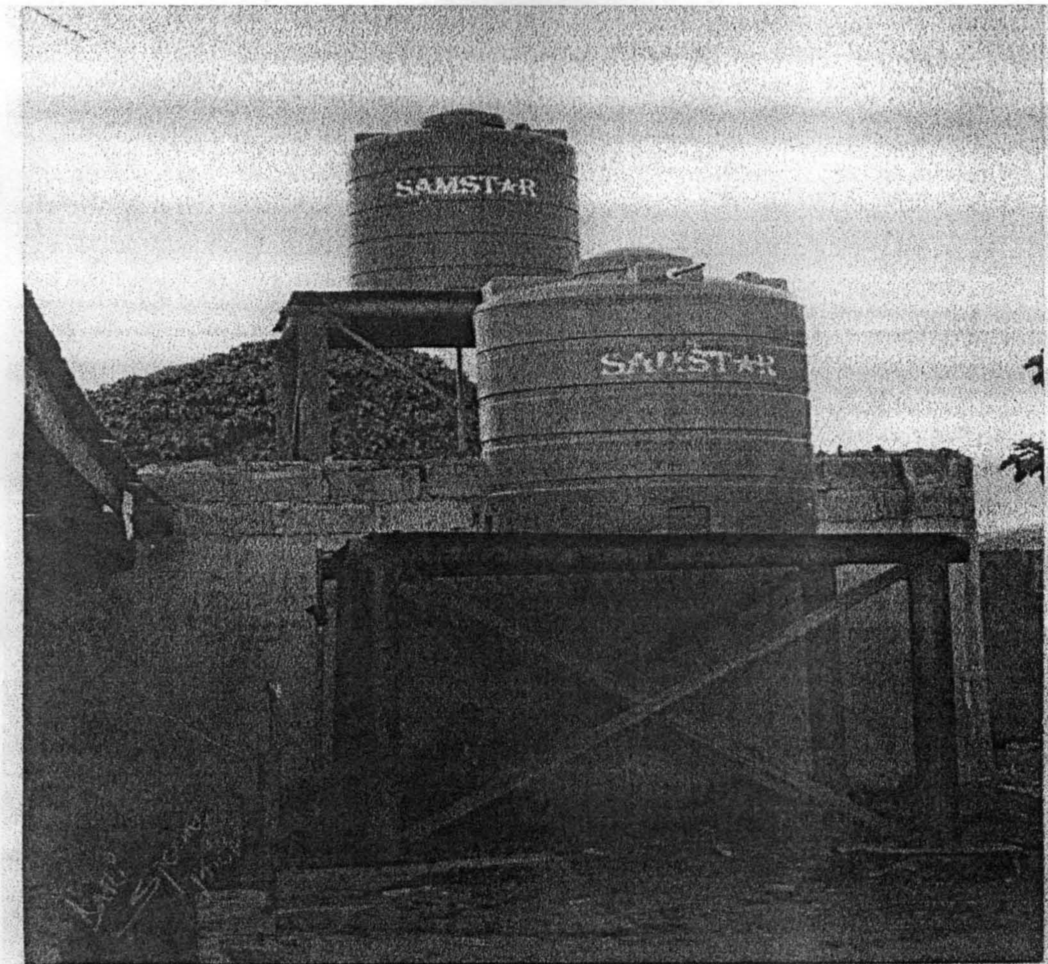


Figure 4.4 above shows two storage reservoir tanks, these are connected to pneumatic operated boreholes, the Red tank serves the household of the owner, while the Green tank serves the public through two headed tap, it is located at Efu Madami Bida behind Alh. Ibrahim Zukogi's house former Chairman. Federal inland revenue services.

TABLE 4.4. THE TYPES OF DAILY WATER USE.

A. Daily water use for cooking and drinking.

QUANTITY (L)	COOKING		DRINKING	
	NO	%	NO	%
< 10	11	2	338	67
11 – 20	20	4	116	23
21 – 30	30	6	30	6
31 – 40	61	12	10	2
41 – 50	136	27	6	1
> 50	247	49	5	1
TOTAL	505	100	505	100

B. Daily water use for washing and bathing.

QUANTITY (L)	WASHING OF PLATES AND COOKING UTENSILS		BATHING	
	NO	%	NO	%
< 40	255	51	136	27
40 – 60	192	38	258	51
61 – 80	50	10	66	13
81 – 100	-	-	30	6
> 100	1	1	15	3
TOTAL	505	100	505	100

C. Daily water use for ablution

QUANTITY (L)	NO	%
< 10	495	98
10 – 15	10	2
TOTAL	505	100

Source; Compiled by the author.

TABLE 4.5

CHARACTERISTIC OF RESIDENTIAL WATER SUPPLY IN BIDA TOWN.

S/No	Name of Residential zone	No of Respondents	No of cuts
1	Bariki	36	20(w) 16(d)
2	Mayaki Ndajiya	47	40(d) 7(w)
3	Umaru Majigi "A"	34	14(c) 20(d)
4	Umaru Majigi "B"	26	10(c) 16(d)
5	Dokodza	46	46(c)
6	Nasarafu	35	35(c)
7	Landzun	34	34(w)
8	Masaba	30	12(w) 18(m)
9	G. R. A	32	32(c)
10	Masaga	34	20(d) 14(w)
11	Banyagi	37	27(d) 10(w)
12	Wadata	36	36(c)
13	Leniyan	38	38(m)
14	Kyeri	40	28(d) 12(w)

NOTE: Explanation of letter in parentheses:

d = Daily cut

w = weekly cut

m = monthly cut

c = constant supply.

All cuts are average; figures outside the parentheses indicate the number of respondents.

Source: Author.

TABLE 4.6. RESIDENCE ZONES CATEGORIZATION FOR WATER SUPPLY IN BIDA TOWN.

S/No	Zones of constant supply (No cuts)	Zones of Intermittent (weekly – monthly cuts)	Zones of Uncertainty (Daily cuts)
1	Dokodza	5. Landzun	9. Mayaki Ndajiya
2	Nasarafu	6. Masaba	10. Masaga
3	G. R. A	7. Leniyan	11. Banyagi
4	Wadata	8. Bariki	12. Kyeri
			13. Umaru Majigi "A"
			14. Umaru Majigi "B"

TABLE 4.7. CHARACTERISTICS OF PUBLIC OUTLETS IN BIDA TOWN.

S /No	Name of zone located	No of outlets	Functioning	Non - functioning
1	Bariki	23	9	14
2	Mayaki Ndajiya	26	7	19
3	Umaru Majigi "A"	21	6	15
4	Umaru Majigi "B"	21	5	16
5	Dokodza	20	3	17
6	Landzun	20	10	10
7	Masaba	22	8	14
8	G. R.A	19	7	12
9	Masaga	21	8	13
10	Banyagi	19	5	14
11	Wadata	25	9	16
12	Nasarafu	25	17	6
13	Leniyan	26	7	19
14	Kyeri	22	2	2
	TOTAL	308	103	205

SOURCE: Bida water works 2000.

TABLE 4.8. CHARACTERISTICS OF GOVERNMENT AND INDIVIDUAL BOREHOLE IN BIDA TOWN.

S/No	Zones located	Govt.	Individual	Total	Functioning	Non function
1	Bariki	3	6	9	9	-
2	Mayaki Ndajiya	3	4	7	6	1
3	Umaru Majigi	4	3	7	5	2
4	"A"	2	3	5	3	2
5	Umaru Majigi	2	4	6	6	-
6	"B"	1	1	2	2	-
7	Dokodza	1	3	4	4	-
8	Landzun	3	2	5	3	2
9	Masaba	3	1	4	2	2
10	G. R.A	2	-	2	1	1
11	Masaga	1	1	2	1	1
12	Banyagi	3	5	8	5	3
13	Wadata	1	3	4	1	3
14	Nasarafu	2	2	4	-	4
	Leniyan	31	38	69	48	21
	Kyeri					
	TOTAL					

Source: Bida water works, 2000.

Arising from the above generally unsatisfactory performance of water supply service in the town the result have a direct relationship with the spatial variations in quantity of water supply to the different zones in the town and confirms why these spatial variations exist. For the supply assumedly falls below the minimum expected values, thus there were zones of constant uncertainty in supply.

CHAPTER FIVE

5.0. RECOMMENDATION / CONCLUSION

5.1. RECOMMENDED MEASURES FOR IMPROVING WATER SUPPLY IN BIDA TOWN.

The problems of water supply in Bida are centred on those of water quality and inadequate quantity to all parts of the town.

This study shows that both sources and distant supplies were vulnerable to contamination. Sources of contamination could be due to broken pipes, old rusted iron pipes, inadequate treatment and contamination at source. Accordingly, it is recommended that all broken pipes and rusted iron pipes should be replaced immediately as soon as they are discovered. Water should be properly treated before being made available for public use. This treatment is emphasized particularly of water from those sources, which are vulnerable to contamination. Boreholes sites / hand dug wells whose soil layers are likely to be sources of contamination should be avoided.

The problem of inadequate supply could be very disturbing particularly in a large town like Bida. Installed capacities of the various water works must be high enough to meet the demand. Such installed capacities must be guided by sufficient data and inadequate of demand factors.

Since water is needed for domestic, commercial and even industrial uses, forecasting of different users and projections of their specific demands with respect to past trends and by application of known extrapolation techniques would ensure adequate present and future supplies. In doing this, the following six components of demand are requisite for determining water supply:

(i). Domestic use in the home;

(ii). Use in small shops and commercial premises;

(iii). Fire fighting etc;

(iv). Use in factories, schools, hospital etc;

(v). Industrial yse, and

(vi). Leakages from mains.

5.2. CONCLUSION

In this study, attempt has been made at identifying and measuring the magnitude of water problems in Bida. Surveys and comparism of laboratory analyses confirm spatial variations in both the quality and quantity of water supply in town. Contaminations at source and distant supplies through broken and rusted pipes are likely responsible for the variations in quality of supply while inadequate supply is responsible for variations in quantity. It is established that the quantity of water produced is far less than the demand for domestic, commercial and even would be industrial purposes. Water boards do not have any forecasting model currently and therefore cannot forecast and take into account all variables and factors of demand. A more disaggregated model has been recommended for determining present and future domestic water demands. Improvement on the quality (through treatment at source and maintenance of supply lines) and quantity (through increased production based on established demands) of water in Bida requires political will to commit the much-needed financial outlay. When this is done and other recommendations implemented. It is hoped that the perennial problems of water supply in Bida be solved.

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APPENDIX 1

QUESTIONNAIRE

DETERMINATION OF PUBLIC WATER SUPPLY

Zone of respondent……………………………………………………………………

Please tick where applicable in terms of pipe borne water supply to your residence.

Daily Supply	
Weekly Supply	
Weekly – Monthly Supply	
Monthly Supply	
Constant Supply	

APPENDIX II

A TECHNICAL FIELD SURVEY OF SUPPLY SCHEMES

RESPONDENT ……………………………… NAME OF THE

AREA……………….

RANK……………………………………………..

DATE………………………………..

TYPE OF SUPPLY

	River and surface water treatment point / gravity fed pipe	BORE HOLE With electri/ diesel engine pump and pipe line	Shallow well and hand pump borehole	Total
No of supply inspected No out of order % out of order				
River / bore hole / well with poor yield				
River / bore hole / well liable to pollution				
Public standpipe out of order.				
Pump break down				
Engine break down				
Constant power failure experience				
Pipe leaking				
Serious tap leakage/ breakage				
No of house hold per supply				