TITLE PAGE

THE IMPROVEMENT OF COMMUNITY WATER SUPPLY A CASE STUDY OF JEGA TOWN KEBBI STATE

A DISSERTATION

BY

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DEDICATION

First to Almighty Allah, for He is doing great things in my life. This study is heartily dedicated to the memories of my late father ALH. MUSA ABI (May his soul rest in peace) and my mother FATIMAH. Last but not the least to my wife MALLAMA MARYAM MUHAMMAD and children Lukman and Sherifa Usman

CERTIFICATION

THIS is to certify that this research work is conducted by me to meet the requirement for the award of a Post Graduate diploma (PGD) Environmental Management) in Geography Department, School of Sciences and Science Education, Federal University of Technology, Minna, Niger State, Nigeria.

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TABLE OF CONTENTS

TITLE PAGE ---------- i

ACKNOWLEDGEMENT---------- ii

DEDICATION---------- iii

CERTIFICATE---------- iv

TABLE OF CONTENTS---------- v

ABSTRACT---------- vi

CHAPTER ONE

1.0 INTRODUCTION 1

1.1 STATEMENT OF PROBLEM 2-3

1.2 JUSTIFICATION 4

1.3 AIM AND OBJECTIVE 4

1.4 SCOPE OF THE PROJECT 5

CHAPTER THREE

2.0 LOCATIONAL ASPECT 6

2.1 GEOLOGY 7

2.2 DRAINAGE PATTERN 8

2.3 SURFACE AND SUB-SURFACE WATER SOURCE 9-11

2.4 CLIMATE CONDITION 11-13

CHAPTER THREE

3.0 LITERATURE REVIEW 14

3.1 GROUND WATER INVESTIGATION 15

3.2 GEOLOGICAL OBSERVATION AND INVESTIGATION 15

3.3 WELL LOGS 15

3.4 PHYSICAL ASPECT OF THE EXSTIVE G/WATER 15

3.5 GEOPHYSICAL METHOD 16

3.6 GEOLOGICAL FORMATION OF AQUIFERS 16

3.6.1 AQUIFER 16

3.6.2 CONFINED AQUIFER 16

3.6.3 UNCONFINED AQUIFER 17

3.7	DESIGN AND CONSTRUCTION OF BOREHOLE	17
3.7.1	ROTARY DRILLING METHOD	18
3.7.2	DEPTH OF BOREHOLE	19
3.7.3	BOREHOLE DIAMETER	19
3.7.4	BOREHOLE SPACING	20
3.7.5	BOREHOLE SCREEN AND CASING	20
3.7.6	BOREHOLE GRAVEL PACKING	21
3.7.7	BOREHOLE INSTALLATION	21

CHAPTER FOUR

4.0	DATA COLLECTION	23
4.1	THE USE OF QUESTIONNAIRE	23
4.2	INTERVIEW	23
4.3	THE USE OF LIBRARY RESOURCES	24
4.4	METHOD USED IN DATA COLLECTION	24
4.5	METHOD OF DATA ANALYSIS	24-26

CHAPTER FIVE

5.0	DATA ANALYSIS AND RESULT INTERPRETATION	27
5.1	DATA ANALYSIS	27
5.2	RESULT INTERPRETATION	27-29

CHAPTER SIX

6.0	CONCLUSION AND RECOMMENDATION	30
6.1	CONCLUSION	31
6.2	RECOMMENDATION	32

ABSTRACT

Water is an important requirement for domestic, industrial and public uses. Therefore this project, that is Improvement of Water Supply to Jega Town in Kebbi State, looks in various ways of ensuring adequate water supply to the community, through drilling of additional boreholes, erection of overhead tanks, diversion of supply mains of the existing four boreholes to the proposed ones and extension of distributions.

The desire is to ensure that the water demand for the coimmunity would be met for at least the next 20 years, since the present supply from existing boreholes does not meet the demand of the people.

This results of the interview conducted shows that majority of Jega community were getting their water supply from the existing four boreholes but still the supply in adequate because out of the four existing boreholes only three are in operation.

As observed, the geological condition of the area is good, because it shows the presence of and aquifer, which indicate a high ground water storage, which could permit the drilling of additional boreholes in the town.

CHAPTER ONE

1.0 INTRODUCTION

This project deals with the expansion of Jega water supply. At present, the town is being served by four bore holes with overhead tank sited at the Northern part of the town, but it is inadequate in meeting the demand of the inhabitants in future due to the fact that the town is rapidly expanding and changing socially, economically and commercial. Water plays a vital roles in sustaining life as it constitutes about 90% for human body, it is the greatest gift to man and essential to both plant and animals, thus, without water, life on earth will not exist. Safe drinking water plays an important role in the control of many water – related diseases such as typhoid fever, cholera, dysentery and diarrhea. It was estimated that as manages with drinking water. (HOFKES E. H1982).

Today inadequate water or unsafe water generally is one of the most encountered problem of Jega town as 40% inhabitants of the town depend on open wells, ponds and this problem is mostly every where in the Northern part of Kebbi State around Kangiwa and Arewa Local Government Areas of the State. Kebbi State is blessed with rich ground water (higher aquifer) which can be tapped and used for drinking and other domestic use (WARD DROP, 1988). Ground Water is the rainfall that infiltrate the soil and penetrate to underground strata (WILSON AND PAUL, 1982).

In view of that it has been decided to expand water supply of the Jega Town by drilling of additional boreholes and overhead tank taking in to

consideration to the future population and development of the town. Jega town is in Sudan Savannah region of the country in Kebbi State, which means the people source of water is mainly on underground.

The environmental problem affecting the town are flood from Zamfara River, drought, gully erosion, desertification, socio-ecopnomic impact and poor refuse disposal. The drilling of boreholes in Jega Town was initiated by the former North Western State Water Board and SARDA in the former Sokoto State because it is one of the simplest and least costly method of supply the town with water. Borehole play great role as source of drinking water in rural areas and semi urban water supply like that of Jega Town. If properly designed, drilled and developed, a borehole is capable of supplying drinking water for about five – ten years without (caving) and total drying up (MICHEAL, 1978).

1.1 STATEMENT OF THE PROBLEM

There is insufficient water supply in Jega town due to the poor design of the pattern as all the four borehole and other overhead elevated tank were sited in the northern part of the town. There is higher demand of Water due to rapid population increase in Jega town, where by the presence water systems were in adequate to sufficiently provide the inhabitant of the town. The existing surface drainage systems are generally inadequate and the problem of sullage is likely to become significant without improved surface water waste drainage systems. In Jega Town, domestic water waste disposal practices are virtually unregulated,

resulting in the potential contamination and deterioration of both surface and underground water quality.

The Zamfara River flow through Jega Town, which cause flood every year in the southern part of the town. The Zamfara River is far away from the areas that need water works treatment plant so as to overcome the problem of water of Sabon Gari, Unguwar Zabarmawa and Ni'ima areas all is in Jega Town (see figure 1.14).

In construction of water works treatment plant it will cost government a lot, so it would be cheaper for the State Government to drill additional boreholes and elevated overhead tanks to the affected areas.

The inhabitants of Jega town mostly dump their waste in the drainage and this may result to environmental problems of water related diseases such as typhoid, cholera, guinea worm, dysentery and diarrhea. The Jega town, being located in Sudan Savanna region of the country, have problem of drought which result in the ground water table falling where groundwater use is high, and is the third most significant geological hazard in terms of economic losses produced ranging only behind floods and frost damage (HAAS, 1978) As population increase agricultural production will also increase significantly which lead to greater use of inorganic fertilizer and pesticide in the flood plain of Jega areas. This pollutes shallow ground water reaching the deeper aquifers over the planting period. The deforestation rates in the unsaturated zone, there by reducing the yields of the various aquifers (PARKMAN NIGERIA LIMITED 1991).

1.2 JUSTIFICATION OF THE PROJECT

Following the boreholes drilled by Northwestern State Water Board, and RUWATSAN in Jega Town in order to supply the town with adequate portable water, the inhabitants are still facing problems of inadequate water supply. It is therefore important to review the existing boreholes, and to drill additional boreholes to overcome the problems of the affected area, whose main sources of water was from open wells, which can be easily polluted, and result to water related disease.

1.3 AIM AND OBJECTIVES

The project aim to provide Jega town with a framework for providing portable water in adequate quality and quantity, and at a reasonable cost.

To achieve this aim, the following objectives have to be considered.

1. To estimate optimal water demand of the community, considering the present population and the population growth trend
2. To examine the distribution of pipeline in the community and proper solutions on construction of new pipelines in order to cover the whole community.
3. To carry out geological survey, so that aquifer with high potential of ground water storage would be located to be utilized later for additional water supply in the town of Jega.
4. To carry out interview with the residents of Jega, town in order to determine the nature of water supply to the community.

1.4 SCOPE & LIMITATIONS

The scope of this project is to expand and provide adequate portable water to Jega town by drilling additional boreholes and water work treatment plant. The extent of this project is only limited to the drilling of additional boreholes to provide the town with portable water at a reasonable cost.

CHAPTER TWO

2.0 STUDY AREA

Jega is the Head Quarters of Jega Local Government Area of Kebbi State and is located at Latitude $12^0$13'N and longitude $4^0$22'E lies on the main confluence of Birnin Kebbi State Capital of about 36km south of Birnin Kebbi and Sokoto road respectively. The town experience long period of dry season and very short rainy season being in the Sudan Savannah region of the Country (PARKMAN 1997).

The Jega Local Government Shares boundaries with Maiyama, birnin – Kebbi, aliero and Gummi Local Government in Sokoto State. (See figure 2.0.1) Kebbi State Map. The inhabitants of Jega Town are mainly farmers and the business men, the Zanfara River flows through Jega town and is personnial. The fadama near Jega is flood plain which encourage the people to carry out irrigation farming in the dry season. (PARKMAN, 1997).

There are five primary schools, two post primary schools, Haliru Abdu Arabic College and Government Day Secondary School as well as post secondary Institution, that is School of Health Technology, Jega. There is also General Hospital and some State Government Ministries at Jega, such as Ministry of Works, Landlord Housing Ministry of Agriculture, Kebbi Agricultural Rural Development authority and Local Government Authority were all established in Jega town.

In terms of social facilities, the town was served with water supply by four boreholes with their submersible pumps from elevated steel reservoir and power

supply from NEPA, and the distribution system spreads in some part of the town feeding 36 standpipes and over 600 house connections. In addition, some houses have dug open wells as their main water supply, the town has also communication network.

The geological formation of the town is sedimentary deposit in Rima Group of Sokoto basin and the drainage pattern of the town was inadequate.

2.1 GEOLOGY

The geology of Kebbi State is characterized by thick and vast sequences of sedimentary deposits of the Sokoto basin which underline about 75% of the state. The geology of Jega Town is sedimentary deposit found in Rima group that composed cretaceous of Wurno Takola and Gundumi Formations which mainly consists of clays, coarse sands, limestones, mudstones, fine to course grained and sand stones. Jega is underlain by the aquifers of the Wurno, Takola and Gundumi formations, (See figure 2.1.1).

The Wurno formation marks the top unit of the Rima group and consists of about 25m to 50m of pale fine sand and some silt. In a borehole at Dogon-daji which has the same formation was found to be gravelly and yellowish brown and white. The Takola formation is the oldest of the Rima group and consists mainly mudstones and fine to coarse grained sand stones. The Gundumi formation occupies only a tiny strip consists of clays, sandstones and conglomerates of locustrine and fluviatile origin (PARKMAN INTERNATIONAL PARKMAN NIG. LIMITED 1997).

2.2 DRAINAGE PATTERN

Drainage systems are required to move excess water from the lands which would have caused waterlogged and localized flooding. The major sources of excess water are the flooding of low lands due to over flow of rivers and natural artificial channels during periods of maximum stream flows caused by excess rainfal shallow water table depth caused by upflow from an artesian aquifer and ground water flow from unconfined aquifers under small hydraulic slopes.

Jega town was in a low land area and have problem of gully erosion every year during the rainy season. There was drainage constructed throughout the town down to the Zamfara River, which flows in the southern part of the town. The inhabitant of the town dump their waste product and some death aquatics species in the drainage, which will be carried down to the River Zamfara in the rainy season.

The dumping of this waste products in the drainage may cause several environmental effects, as its may result to outbreak of disease such as cholera, guinea worm and many communicable diseases. The pipelines that passed through the drainage can be polluted by the waste product dump on them, and also leaded pipes that passed through contaminated water the drainage can pollutes the water supply which is not safe for human consumption. As most of the inhabitants in Jega town, about 40% of them depends on open wells and some on zamfara River where all this waster refuse are to be deposited and can pollutes surface water as well as ground water when the toxic waste penetrate in the ground. The ponds and streams are perennials, the waste dump in the drainage may pollutes the ponds and

the streams as well as open wells, and some part of Zamfara River that passed in the Southern part of the town which may result to water-borne diseases such as guinea worm, cholera, bilthazia and diarrhea.

The drainage pattern in Jega town are inadequate and is so localized as most of the development areas of the town does not have even localized drainage and the existing drainage could not accommodate the volume of water flowing through the drainage in the rainy season. The benefits of adequate drainage systems include land and soil reclamation, control of erosion, increased soil productivity, and agricultural potentials, all this are lacking in Jega town as the towns was in low land area. The town has problems of gully erosion and drainage pattern are poorly design to control erosion menace.

The surface and sub-surface drainage systems are commonly used to remove excess water from lands. The surface drains are designed to remove excess run -off from lands while sub-surface drainage is designed to remove excess water from the soil mass and is associated with the control of water table depth.

2.3 SURFACE AND SUB-SURFACE WATER SOURCES

The principal main sources of water are surface and ground water. The surface water include water from streams natural water artificial reservoir rivers estuary and direct precipitation. The subsurface water resources are upland springs, artesian springs infiltration, galleries, shallow or deep wells. The upland springs are the most ideal source because of their less degree of contamination and artesian wells are not easily contaminated because the aquifer is under pressure

and its considerable distance from the recharge area, it undergo natural infiltration before it is abstracted. In choosing a water source, it is preferable to find one which supplies sufficient good quality water and protect it from contamination or pollution, rather than choose from an unsuitable source and treat it. Springs and ground water are the best choice for development except where the source have dissolved salts or aesthetically unpalatable.

The main sources of water to the inhabitants of Jega town is surface and underground water. The surface water sources are from ponds and streams which are perennials and also open well which 40% of the household in Jega depend on, every dry season, as part of community projects, wells are ponds are deepened. (PARKMAN INTERNATIONAL/PARKMAN NIG. LIMITED 1997). The surface water are prone to serious contamination and pollution and often require extensive treatment because of fluctuation in quality caused by climatic and environmental conditions and it require a large capital in each of the development stages of the supply.

The surface water source of Jega town can also be from river and water storage basins which can be determined by many climatic and geomorphologic factor and conditions of soil geology (PARKMAN 1997).

The sub-surface is a vital source of water supply especially in areas where dry summers or extended droughts cause stream flow to stop. The main source of sub-surface water is precipitation, which may penetrate the soil directly to the groundwater. (FLETCHER, 1986). The sur-surface water in Jega town can be affected by drought as the rate of ground water recharge is usually insufficient to

keep pace which discharge to rivers during the years of droughts, which may result to groundwater table falling several feet especially in sub-humid areas where groundwater use is higher (FLECTCHER, 1986). The recharge water must be chemically compatible with existing groundwater and have a suitable temperature.

The sub-surface has an advantages as a source when compared to surface water it yields water which is safe and may require only disinfecting or no treatment at all. It provides a sufficient storage to cope with seasonal variations in demand and supply, and prolonged dry periods. It requires low cost in installation, treatment and the transmission to supply water directly to the consumer. Jega is underlain by the aquifers of the Wurno, Takola and Gundumi formation with three functional boreholes providing the water supply to the town. The boreholes were constructed by north western state water board with good yields (PARKMAN 1997). The Zamfara River flows through Jega and is perebnnial, dry season flows is less and even at 24 hours per day this flow will not be enough to meet the water demand of the inhabitants of Jega by direct abstraction from the River.

Due to higher cost that would be involved in impounding and treating the water flow from the river source, it is proposed to utilize the ground water that is available in the area which is very good for human consumption (PARKMAN 1997).

2.4 CLIMATE OF THE STUDY AREA

The climate of Jega is semi-arid with prolonged dry season extending normally from October to April and wet season from May to September. The

climate can be transition zone between semi-arid Savannah in the south to arid condition in the North of Jega town. (PARKMAN 1997).

Information from Water Resources Ministry shows that rainfall begins from the month of late May to early October. The average rainfall is about 1200mm in the South and less than 700mm in the North. The rainfall at Jega is very unusual from end of October to April. The earliest part of the dry season tend to be the coolest time of the year that is November to February each year and sun attains high temperature from 25^0c to 45^0 C. The relative humidity is as low as 12% in the month of August and average evaporation is about 400mm.

Normally the wind blows Southwest during the rany season and blows East during the dry season (harmattan). The rainy months are associated with the NorthWard movement of the Inter Tropical discontinuity across Kebbi State on which Jega town was affected. During this period relative humidity is high and winds are mainly South-Westerly.

The Southward movement of the inter tropical discontinuity occurs in October to November and signals the beginning of the dry season, with low relative humidity, cooler air temperatures and from December to February, extended spells of the Harmattan, a seasonal air current bring dust from the sahara.

Jega town is within the Sudan Savannah region of the Kebbi State with long period of dry season and very short rainy season with an annual rainfall of about 600mm. Rainfall is from late May to early October and amount to more than 1200mm in the South to less than 700mm in the North. Rainfall is absent or very unusual from end October to April)

Jega being in the Sudan Savannah has short grasses and some trees such as silk cotton tree, famous harbab trees, few gum Arabic, and shrubs (PARKMAN 1997).

CHAPTER THREE

3.0 LITERATURE REVIEW:

It is known that throughout man's history, a dry borehole has been an integral part of his life for supply clean water. The drilling of borehole dates back to the 12th century with the successful drilling of borehole at Artoise, France in 1126 (PAUL 1966). Before the advert of method of drilling boreholes for tapping ground water the ancient Persians constructed tunnels to tap groundwater for their uses, later the Egyptians and Chinese started using drilling method of drilling sources and since then, the general method of drilling were practiced in many part of the world, such as in England and Germany. Boreholes have been used as a source of drinking water in many countries since 12th century (MICHAEL 1978).

In Nigeria, drilling of borehole has been introduced to overcome the problem of drinking water to semi-urban and rural areas and prevent the growth of water-related diseases. Borehole has been introduced in Kebbi State by the Sokoto Agricultural Rural Development authority (SARDA). Field trials on boreholes constructed were first initiated in the start and local government areas successful borehole were drilled with good yields.

Due to the success, decision was made to cover the whole semi-urban and rural areas of the state by importing Rotary drilling for well construction in the State (SARDA WARD DROP CONSULTANTS PROJECT 1988).

3.1 GROUND WATER INVESTIGATION

Before embarking on borehole constructions it is important to have full knowledge of groundwater reservoirs. This is necessary in order to avoid failure of borehole as well as to ensure proper development; effective removal and efficient utilization of groundwater to obtain the required data. Four approaches are normally adopted viz.

3.2 GEOLOGICAL OBSERVATION AND INVESTIGATION:

This can give outline the physical future of the earth surface and can give idea about sub-surface conditions. Physical surface feature and geological patterns give an idea of what can or cannot be reasonably expected below the surface especially concerning the occurrence of suitable aquifer from which water can be withdrawn (PAUL, 1996).

3.3 WELL LOGS:

The most reliable method of learning about the earth surface is to drill through and obtain sample while drilling and records the logs of boreholes. Well logging consists of recording the characteristic properties of the samples of sub-surface materials obtained during the process of drilling.

3.4 PHYSICAL ASPECT OF THE EXISTING GROUNDWATER

The physical aspect of the existing groundwater to be considered are water table, elevation and water movements can often give us an idea on the existence of groundwater (FLETCHER, 1986).

3.5 GEOPHYSICAL METHOD

This is based on upon detecting the difference in physical properties of surface and sub-surface materials. The method provide an indirected evidence of sub-surface formation that indicates weather, the formation are likely to be aquifer. It only measures other properties of the materials, which determined a good aquifer. The groundwater occurs in permeable geological formation known as aquifer. The word aquifer originated from Latin (meaning water-bearing) its formations having structures that permit appreciable water to move through them under ordinary field condition (David, 1980).

3.6 GEOLOGICAL FORMATION OF AQUIFER

Groundwater occurs in a consolidated rock material (hard core) and in loose unconsolidated materials (soft-rock). Any type of rock: sedimentary, igneous or metamorphic, whether consolidated or unconsolidated may be aquifer if it is sufficiently porous or permeable. The flood plains contain sand, gravels and are the best aquifer since floodplain contain a lot of deposit and large amount of water stay over them and finally percolate to groundwater (David 1980).

3.6.1 **AQUIFER**: An aquifer is a water-bearing formation capable of yielding sufficient water to satisfy a particular demand. Aquifer can be classified into two, namely; confined and unconfined aquifer.

3.6.2 CONFIRMED AQUIFER: An extension is confined by upper and lower impermeable layers. They occur where groundwater is confined under pressure greater than atmospheric by underlying relatively impermeable

strata. Water in a well drilled in to the formation will rise above level of aquifer and may actually flow at the surface.

3.6.3 **UNCONFINED AQUIFER**: This is the aquifer that separate groundwater from main groundwater by a relative impermeable stratum. A small extent and by the zone of aeration above the main body of groundwater, in terms of tapping groundwater unconfined aquifers yield small quantities of water.

The groundwater potential of Jega town, which is in Wurno and Gundumi formation, was good (see figure 3.6.3). The water in the Rima Group occurs under unconfined conditions at the out strip area and under confined conditions drown, dip and has been known to provide artesian boreholes (PARKMAN 1997).

Recharge to the aquifers is both by direct infiltration of rain water and indirect by perculation from river and stream flow. The aquifers are presently underdeveloped and there is discharge of groundwater from the aquifers from springs, which maintain the dry season flow of the Lower Rima and its tributaries. There is however need for aquifer monitoring to ensure that abstraction does not outstrip the recharge leading to an overdraft (PARKMAN 1997).

3.7 DESIGN AND CONSTRUCTION OF BOREHOLES

There are many method normally used world-wide in construction of boreholes, but the method normally practiced in Kebbi State are:-

(i) Rotary Drilling Method

(ii) Cable Tool Method.

Each of the above method used in the drilling has advantage related to the ease of construction and characteristic of formation

3.7.1 ROTARY DRILLING METHOD

The rotary drilling method requires the use of a rotating bit for drilling the borehole. The drilled material is continuously removed by a circulating mixture of water and clays or any other conditions, which are pumped into the well. The clay logs the well walls preventing collapse of the borehole. This drilling method is suitable in any soil or rock formation and the acquisition of the equipment are high drilled deep wells have maximum protection from contamination and pollution but often have objectionable mineral salts, sulphur e.t.c. The rotary drilling consist of cutting head attached at the end of the drilling pipe, on which all are attached to the rotating device. A drilling bit is used to make hole initially in the ground surface and slowly until it penetrate deep down the formation thus, transporting the cutting upward outside the hole inform of solution. The solution is then channeled into the setting basin and then flows into the picking basin through a channel linking the two basins. The circulation is continued until the required depth is reached. The most important component in drilling is the drilling bit and drilling mud. Drilling bit is use in cutting and making the hole while drilling mud is used in softening cementing agent on the internal wall constructed by bit (PAUL 1966).

The Rotary Circulation machine were designed and were used only in unconsolidated formation recently, circulation drilling has been used in soft consolidated rocks such as sandstone and even in hard rocks using both water and

air as the drilling fluid. The circulation drilling is the least expensive method for drilling large diameter holes in unconsolidated formations. When geologic conditions are favourable increasing the diameter of the borehole does not appreciably increased the cost of the well, therefore, most water wells drilled by this method are 24 inches (610mm) diameter. The reserved circulation drilling is most successful in soft sedimentary rocks and unconsolidated sand and gravel where rocks and unconsolidated sand and gravel where the static water level is left (3m) or more below ground level. The reserve circulation drilling method may not be satisfactory when the static water level is too high and adequate water supplies are not available. (FLETCHER 1986).

There are many points to be considered when constructing a borehole in order to achieve successful and durable borehole some of the parameters are as follows:

3.7.2 **DEPTH OF BOREHOLES**

Usually in boreholes construction there is no limitation to the depth of well rather it is determined by the depth or position of site aquifer borehole depth may seriously influence the performance of the hole should reach up to the third aquifer below the ground surface to avoid the draw-down of the water in borehole especially during the long period of drought.

3.7.3 **BOREHOLE DIAMETER**

The choice of diameter may not be over-emphasized since the cost of materials to be installed and also the diameter constructs to the case of

maintenance and drilling of boreholes. Normally the diameter ranges from 6" (150mm) to 8" (250mm), depending the capacity of the drilling equipment.

In choosing of borehole diameter we have to bear in mind that the larger choice of suitable diameter is important.

3.7.4 BOREHOLE SPACING

The spacing of borehole is very important and depending on the population size a borehole installed is going to serve. If care is not taken, and the boreholes were constructed near each other, the yield of other borehole will be affected as there will be competition between the two. The result will be total low yielded borehole, which is time and money wasting.

The recommended borehole spacing in Kebbi State is 150 meters apart, in order to avoid the low recharge transitivity and low storage co-efficient spacing of borehole is of great importance.

3.7.5 BOREHOLE SCREEN AND CASING

It is very important to prevent the sand and silt from entering the borehole screen and casing pipes to avoid blockage.

Screen placed in a constructed borehole stainer, which prevents the fine sand, fine aggregate or any foreign bodies from entering into the borehole and the casing were fixed down into the lower basement of the pipe. The borehole screen is very important to satisfied the following basic requirement:

1. It should be resistant to corrosion
2. Suitable to prevent the collapse movement of sand into the pipe
3. It should be very strong to prevent the collapse (cave-in) of borehole.

3.7.6 **BOREHOLE GRAVEL PACKING:**

In underground formation where there is time sand, it is necessary to apply gravel packing if is not present naturally. Thus, artificial once is necessary. Gravel packing is a thin layer of course gravel formed around the screen lowered into the borehole. The main function of gravel packing is to replace the fine sand or silt around the screen in order to avoid the siltation and also to increase the boreole yield (PAUL, 1966).

3.7.7 **BOREHOLE INSTALLATION**

A borehole is installed with piping materials after the completion of the drilling. In placing the materials the casing is placed on top of the screen and then lowered into the completed borehole with the screen at the bottom of the hole. The screen is provided with a plug at the base entering of the sand into the pipes. The screen is provided with a plug at the base entering of the sand into he pipes. The important aspect here is the full knowledge of the drilling profiles and water level (PAUL 1966).

Based on invetigation, the boreholes drilled by WARDDROP CONSULTANTS to SARDA, J.M. DESCHAMPS CONSULTANT, to North-Western State Water Board, in 1976, Anderson and Ogilbee, and RUWATSAN boreholes drilled in Bunza, Gwandu, Jega, Argungu and Benin – Kebbi Local Governments of Kebbi Sate are the most potential areas for ground water exploitation whereby a high successful rate and yield could be expected from these areas and very good water qualities for domestic use (PARMAN 1997).

SITE WITH SUCCESS RATE AND RESPECTIVE YIELDS

LOCAL GOVT.	NAME OF TOWN	DEPTH (M)	AQUIFER (M)	YIRLF (LLM)	WATER LEVEL (M)	DRAW DOWN (M)
Bunza	Bunza 1	60	48-45	14	21	22
	Bunza 2	66	60-65	24	21	11
Gwandu	Gwandu	33	24-31	4.5	10	
Jega	Jega 1	91	48-84	24	27	
	Jega 2	73	48-85	20	24	
	Jega 3	90	48-85	55	18	
Argungu	Argungu	62	41-43	36	8	
	Argungu 2	81	71-76	13	15	
	Argungu 3	37	62-69	36	-	
Birnin Kebbi	B/Kebbi	96	72-93	65	31	
	Birnin 2	108	60-84			
	Kebbi 3	103	69-91			
	Kebbi 4	139	108-135`			

(PARKMAN INTERNATIONAL 1997)

CHAPTER FOUR

4.0 DATA COLLECTION

Data collection is one of the major requirements in any academic survey, as data is referred to collection, tabulation and diagramatic e.t.c. representation of information.

There are various ways through which data can be collected. Among these method are:

1. The use of questionnaire
2. Interview
3. The use of Library resources

4.1. THE USE OF QUESTIONNAIRE

This is the collecting of data those details the list of printed question to be answered by respondents, and is the most effective method of collecting data. There can be also be questionnaire of purely administrative nature, marked research and social survey questionnare.

4.2 INTERVIEW

In interview, the enumerator does not usually deliver the questionaires but ask relevant questions to the respondent. The questions could be listed, if not many, during the interview. The enumerator is responsible for obtaining accurate information he must not express his opinion, nor must he allow them to influence the answer.

The enumerator must record facts accurately an ensures that he is interviewing the right person should explain the purpose of interview as clearly as possible and should not put answer into the respondents mouth. Where the question asks for an opinion it should be clear and well explained.

4.3 THE USE OF THE LIBRARY RESOURCES

This is the information collected by consulting different books and other relevant text materials on the topic concerned. From these sources, fact and relevant information could be obtained from books, seminar papers and articles written by different authors.

4.4 METHOD USED IN COLLECTION DATA

This study was set up in order to explain and obtain a comprehensive information in Jega Town Water Supply in Kebbi State a case study of expansion of water supply is Jega town. With the above in mind, interview was used for the purpose of getting required information. For a typical interview questions see appendix I

4.5 METHOD OF DATA ANALYSIS

For the design of water supply project, it is necessary to determine the amount of water that is required. This can be done by knowing the total population that will be served and their per capital water demand, together with an analysis of the factors that may operate to affect the demand. Any water supply system must be planned to serve the present as well as future needs of the community.

For construction of water supply project, decision have to be made as to the length of time the improvement will serve a community that is to forecast as accurate as possible the population of 10/20/30 years in the future which is known as design period.

1. POPULATION PROJECTION

The projected population of Jega Town as of 2000 year was 44,192 (Parman 1997). The method used in population forecasting or prediction include Arithmetic method, Geometric method and comparative method.

The Arithmetic method involves the calculation of an average decade in the past record. This is then added to the present population to the population for the next decade. For the case of Jega Town, the community was served with four boreholes and out of the four, only three were in operation and all the boreholes were located in the Northern part of the town, still also, about 40% of Jega town community.

2. DISTRIBUTION SYSTEMS

Distribution System for public water supply are networks of pipes within networks of street plan topography and location of water supply works together with service storage determine the type of flow through it. A network of pipes is used to distribute water to a community.

There are two types of distribution systems namely looped and branched, the grid pattern that with large diameter pipe loop around an area. With a high demand for water, a combination of these system is used. In pipes with dead ends

the flow of water is always in the same direction and water is supplied to an area by couple pipe.

The distribution systems of Jega town of both existing and proposed ones was a grid pattern (Parkman, 1997).

In a grid pattern, all the pipes are interconnected with no dead ends, so water reach any point more than one direction. The existing distribution of Jega town does not cover the whole town, it only covers the Northern part of the town where the existing four boreholes are located.

The proposed diameter of pipes mains are 100mm, 150mm, , 200mm, 250mm and 400mm, while the pipe materials are cost iron, galvanized iron, asbestos cement etc (Parkman 1997). The geology of the area is good for drilling of borehole as the aquifer are with high ground water storage. (See fig. 4.5.2)

3. **INTERVIEW**

In the interview, the enumerator does not usually deliver the questionnaires, but ask relevant questions to the respondent. The enumerator is responsible for obtaining accurate information and so that complete objective must be obtained.

So the main objective of interview the to community of Jega town, is to know facts about their boreholes, water sources, distribution networks and geological aspects of the town, and on which part of the town the above listed are located.

CHAPTER FIVE

5.0 DATA ANALYSIS AND RESULT INTERPRETATION

5.1 DATA ANALYSIS

In this case, one hundrted and ten questions were drawn and circulated in Jega town, at the end of the day, the questionnaire were collected and only ninety (90) questions returned safely and readable, so our result will be based on the response of this number.

The analysis is specifically explained in this table (See Appendix I for Questions)

5.2 RESULT INTERPRETATION

To design water supply project, it is necessary to determine the amount of water that is require and the population that will be served and their per capital water demand of the community, by forecasting, as accurate as possible, the population of the present, and the population trend of Jega town.

From the observation made, the community of Jega town main source of water was from boreholes, streams and open wells and the town was served with four boreholes, sited in the Northern part of the town.

As observation shows, the boreholes were drilled in 1976 (Deschamps, J. M. 1976) to the North Western State Water Board and is only supply its water in

the Northern part of the town. Based on the observation obtained, the supply is not adequate, because out of the four boreholes only three are in good working condition, and 40% of the community in the town still depend on open wells.

The open wells used to be polluted by metallic waste which rust out and lead to Iron content, and pit latrines that are constructed near the open wells. This can be controlled by constructing of pit latrines away from open wells as well as avoiding dumping of refuse metals near wells.

From the obsrvation made on boreholes at Jega town, the community does not experience any discharge or yield in their boreholes as the area has aquifer with potential of groundwater storage. As observed the community used to get problem of their boreholes maintenance as it takes some days for the technicians of Water Board to effect the repairs due to lack of maintenance facilities such as drilling rig. Based on the observation made, the boreholes are being maintained by Water Board, and the community contribution on boreholes maintenance was to report immediately to the board on any problem that might arise. The advise community give to the government was to purchase drilling rig to the board for the ease of maintenance of the boreholes.

As observation shows, the community of Jega town prefer the drilling of additional boreholes in the Southern part of the town, rather than water treatment plant, as drilling of boreholes will be cheaper than that of water treatment plant which is very costly. From the observation obtained, the existing distribution pipelines network does cover all part of Jega town. It was only within the

Northern part where the boreholes were located. So, Government is to extend the pipe distributions to cover the whole town.

As observed, the drainage pattern contributes to the environmental problems, because the community of the town dump waste refuse in the drainages which may result to water-related diseases, such as cholera, guinea worm etc.

The drilled boreholes could dry up as observation show due to poor site selection of area that has no aquifer of higher potential of groundwater storage.

By the observation obtained, a suitable aquifer with a high groundwater potential was found in Rima Group of Wurno and Gundumi formations, in which Jega town belong to, and Jega has a good ground water potential as it was in Wurno and Gundumi formations.

Based on observation made on geological aspects of Kebbi State, Jega town belongs to the crataceous of Wurno and Gundumi formations, which consists of clays mudstones, coarse sands, fine coarse grained, limestones and sandstones.

For this project, the Arithmetic method is used and the population of Jega town by the 2020 would be 79,815 (Parkman 1997). The total water demand for a community is obtained by multiplying the per capital litre/day in the population and the factor of safety, these the average daily consumption of the resistant community is known.

The projected water demand of Jega town by the year 2020 is 9,229 litre/day (Parkman 1997). Therefore as the expected population by 2020 years with regard to the litre/day/capital and comparating with present productions to know whether the supply is inadequate or not.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATION

6.1 From the observation made on Jega Water Supply, it was found that only three boreholes are working, out of the four boreholes that are located in the Northern part of the town. It was also found that the three boreholes that are in operation will not serve even the demand of the existing population as 40% of the inhabitant still depend on open wells, which means that the water supply of the town was inadequate.

The geology of Jega town is sedimentary deposit found in Rima Group that composed cretaceous of Wurno and Fumdumi formations which generally have a high groundwater potential. This permit the drilling of boreholes as the aquifer of the area can produce good yield of water.

The drainage pattern of the town was generally inadequate due to poor design, and the inhabitants were dumping their waste refuse in the drainage systems resulting to water-related diseases. The people around Sabon-Gari, Unguwar Zabarmawa and Ni'lma area in Jega town depend mostly on open wells and streams as observation showed which can be easily polluted and normally result to water-related disease.

The environmental problems facing the town was flood from Zafara River, drought and desertification because of its being in the Sudan Savanna region in the

country and also dumping of waste refuse on leak pipelines, this may lead to water-boren diseases, such as cholera, typhoid, diarrhea, guinea-worm etc.

6.2 RECOMMENDATION

The introduction of boreholes for the provision of safe drinking water plays a vital role in terms of solving the shortage of drinking water and prevent water-related diseases in Jega town. Therefore, with regards to the investigation made on the construction of boreholes, the following can be recommended in the provision of safe drinking water:

1. To avoid the drilled boreholes drying up and low yield of water due to poor site selection for good aquifer, it should be recommended that a proper site selection which has a good aquifer with abundant groundwater is required.
2. The existing four boreholes and distribution network to be reactivated so as to get optimal portable water supply in Jega town.
3. As most of the inhabitants of Jega town depend on open wells and refuse were dumped in the drainages of the town, which pollutes the surface water and leak pipelines that passed through the drainage in the same direction, flow of groundwater which may cause water-related diseases, it should therefore be recommendation that groundwater direction should be critically observed when planning for any borehole drilling.
4. The boreholes should be provided with a drainage where waste water will drain to prevent water-logging at the base of boreholes against polluting of groundwater.

5. The additional boreholes shoul be spaced to about 150m distance from eac other to avoid competitions of groundwater withdrawal and should be sited in the southern part of Jega town for easy distribution.

6. The Kebbi State Government should purchase drilling rig to the State Water Board for ease of maintenance of boreholes and drilling of additional ones.

7. The State Government is to make extension of pipeline distributions to cover the whole town for ease of distribution of water.

8. The existing boeholes is to be properly maintained as when connects with proposed ones an adequate portable water to be obtained.

9. The open wells should not be near pit latrines, and the community should be enlightened on the problems of dumping waste refuse near open wells as it can easily pollute their water.

10. To provide the town with adequate portable water supply, additional boreholes are to be drilled in the affected areas with overhead elevated tank, and connect the existing distributions network with the proposed ones.

11. The Kebbi State Government should purchase drilling rig to enable the water Board Staff carry maintenance and drilling of boreholes in the State, as it will be easily to obtain water at less cost than compared to water-treatment plant.

APPENDIX I

Interview with the people of Jega town:

1. Where is your main source of drinking water streams or boreholes.
2. If boreholes how many are there in your town and with site are they located.
3. When were they drilled and with size of the Jega town the boreholes provide water
4. Do you think the supply is adequate if not why
5. As 40% inhabitants of Jega town depend on open wells due to inadequate water supply, do you experience any water pollution on your wells.
6. If yes, what is the cause of that pollution and how do you control it
7. When do you experience low discharge or yield from your boeholes
8. Have you any problem from your boreholes
9. How are they maintained? By community, Local Government or water board.
10. What is your contribution in the maintenance of these boreholes
11. What advice can you give to the Government
12. As Jega town have inadequate water supply, do you want water treatment plant or additional boreholes construction in the town
13. If yes where and which one do you prepare
14. Does the existing distributions network covered all parts of Jega town
15. What advise can you give to the Government if not.

16. Does your drainage pattern contribute to environmental problems in the town

17. What cause drilled boreholes to dried up

18. What aquifer is suitable for drilling of boreholes in Jega town

19. How is the potentiality of Jega groundwater

20. In the geological aspects of Kebbi State, which group of formation Jega town belong too.

FIGURE 2.1.1

TABLE 13.1.1: GEOLOGY OF KEBBI STATE

AGE	FORMATION	ROCK TYPE
(Top) Quaternary	Alluvium	Sands and clays
Tertiary Eocene	Gwandu	Clays & fine to coarse sand
Palaeocene	Kalambaina	Clays, shales & limestones
Palaeocene	Dange	Clays & shales
Cretaceous	Wurno	Clays & coarse sands
"	Dukamaje	Shales & limestones
"	Taloka	Mudstones & fine to coarse grained sandstones
"	Gundumi (Illo)	Clays,sandstones and conglomerates
Precambrian	Basement Complex	Granites, migmatites & metàsediments

FIGURE 3.6.3

Summary of Groundwater Potential

Location	Formation	Groundwater Potential
Birnin Kebbi	Gwandu/Alluvium	Good
Bunza	Gwandu/Alluvium	Good
Koko	Illo	Fair to good
Jega	Wurno/Gundumi	Good
Gwandu	Gwandu	Good
Kaoje	Illo	Fair to good
Zuru	Basement	Poor
Ribah	Basement	Poor
Darin Daji	Basement	Poor
Yauri	Basement/Alluvium	Good
Shanga	Illo/Basement	Fair
Argungu	Gwandu	Good
Kamba	Illo	Fair
Kangiwa	Gwandu	Good

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