AN ASSESSMENT OF POPULATION GROWTH ON PIPE- BORNE WATER AVAILABILITY IN MINNA

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A PROJECT SUBMITTED TO THE
DEPARTMENT OF GEOGRAPHY
NIGER STATE COLLEGE OF EDUCATION
MINNA

SEPTEMBER, 2015

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54

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APPROVAL PAGE

The project work has been read and approved as meeting the requirement for the award of Nigeria Certificate in Education (NCE) in the Department of Biology/Geography, Niger State College of Education, Minna

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DEDICATION

This project work is dedicated to the family of Hon. Suleiman Iman Kibban, Mall. Isah Shaba, Mall. Shehu, Mall. Mohammed and Mall. Kolo.

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ABSTRACT

Pipe-borne water is the major way of urban water distribution globally. However, population growth and industrialization have put a lot of pressure on water resources the world over. Minna, the capital city of Niger State, Nigeria, has witnessed population growth due to the influx of people from the various regions to seek greener pastures. To explore this problem the research was titled "Assessment of population Growth on pipe-borne water, Availability in Minna, Nigeria". The following objectives are recommended which include; to identify the major causes of pipe-borne scarcity in Minna, to identify alternative source of domestic water in Minna and to describe the relationship between population growth and pipe-borne water availability in Minna. Structured questionnaire were distributed to two hundred households purposively selected from six areas in the town, to determine if there exist a relationship between population growth and pipe-borne water availability in Minna. The study was carried out using both primary and secondary data. Data were obtained from an interview with official of the ministry of water resources Niger State. To assess the extents to which pipe-borne water is used for domestic purpose and wake recommendation on urban water provision and identifying any alternative source of domestic water in Minna. Secondary data on population growth from National population Commission which was obtained for 1991-2010 were correlated with annual water production capacity of Minna water works from Niger State water Board. Statistical package for social science (cpss) was used to analyze the data collected; the study reveals that inadequate budgetary allocation to ministry of water resources is the major problem hindering pipe-borne water availability. In addition, the study reveals that majority of the respondents utilized pipe-borne water below 50%, positive correlation (r-0.938) between population and water production of Minna water works was revealed. Consequently increase in resource allocation to the ministry of water resources and creation of demographic department in the ministry of water resources was recommended among other improves pipe-borne water availability in the study area.

Table of Content

Title page		i
Approval page		ii
Dedication		iii
Acknowledgement		iv
Abstract		v
Table of Content		vi-viii
CHAPTER ONE: -	**INTRODUCTION**	
1.1	Background of the Problem	1
1.2	Statement of the Problem	2
1.3	Aim and objectives	3
1.4	Research Hypothesis.	5
1.5	The Study Area	6
1.6	Justification of Study	8
CHAPTER TWO: -	**LITERATURE REVIEW**	
2.1	Urban water Management Policies	10
2.2	Urban Water Management Model	24
2.3	Population pressure on water resources	31
CHAPTER THREE: - RESEARCH METHODOLOGY		
3.1	Data Collection	41
3.2	Administration of questionnaires and Interviews	41
3.2	Data Analysis	44

3.3 Research matrix 47

CHAPTER FOUR: - RESULT AND DISCUSSION

4.1 Description of Result and Discussion 48

4.1 Alternative water source for Domestic uses at Chanchaga 49

4.1 percentage pipe-borne water for Domestic purpose in Chanchaga 50

4.2 Alternative water sources for Domestic purpose at Tunga 52

4.2 Percentage pipe-borne water for domestic use in Tunga 53

4.3 Alternative water source for Domestic use at Kpakungu 55

4.3 Percentage pipe-borne water for domestic purpose in Kpakungu 56

4.4 Alternative water source for domestic use in Limawa 58

4.4 Percentage pipe-borne water use for domestic purpose in Limawa 59

4.5 Alternative water source for domestic use at Keteren Gwari 60

4.5 Percentage pipe-borne water use for domestic purpose in K/ Gwari 62

4.1 Cross tabulation of alternative water sources for domestic use in the study area 63

4.2 Regression analysis of population and water production capacity of Minna water works 65

4.3 Pearson's Correlation Coefficient between population of Minna and water production capacity of Minna water works 66

4.4 Analysis of Interview with Niger State water Board 67

CHAPTER FIVE: - SUMMARY, RECOMMENDATION AND CONCLUSION

5.1	Summary	70
5.2	Conclusion	72
5.3	Recommendations of finding	73
REFERENCE		**75-77**

CHAPTER ONE

Introduction

1.1 Background of the study

The available water resources throughout the world are becoming depleted and this problem is aggravated by the rate of which population are increasing, especially in developing countries. With increasing global change pressures coupled with existing un-sustainable factors and risks inherent in conventional urban water management cities of the future will experience difficulties in efficiently managing scarcer and less reliable water resources (Khatri and Vairavoothy 2007).

It has estimated that one third of the population of the developing world will face severe water shortage or problems by 2025 (Seckler and Rosegrant, 1998). Dzikus (2001) estimated that in Africa 12 Africa countries will be considered to be in a "water stress" situation by 2008. A further 10 Africa countries will be stressed by 2025. A total of 1.1 billion people or two thirds of Africa population will be affected.

Freshwater is the most fundamental of all finite resources. It has no substitute for most uses and it is expensive to manage. But freshwater sources are dwindling or becoming contaminated throughout the world. A cute water shortage is increasingly common in many cities with fast growing

population becoming a potential source of conflict. As populations grow and water use per person rises demand for freshwater is soaring. Yet the supply of freshwater is finite and threatened by pollution. Caught between growing demand for freshwater, on one hand and limited and increasingly polluted water supplies on the other, many developing countries face difficult choices, Sustaining healthy environment in the urbanized world of the 21st century represent a major challenge for human settlements, development and management (Khatri & Vairavoothy, 2007). Today many state capitals in Nigeria are facing chronic freshwater shortage. Minna is one of the capital facing water problems in Nigeria population growth and rapid urbanization have created a severe scarcity of water as well as tremendous impact on the natural environment. In order to meet the future water demand, Minna city will need to tap her water supply either from deep around or surface source situated for distance away from the urban area. Moreover, rapid increase in built up are disturbs the local hydrological cycle and the environment by reducing the natural infiltration opportunity (natural and applied science in department of federal university of technology Minna).

Minna is already faces with enormous backlogs in shelter infrastructure and services and environmental position, large population will

demand large population of water while simultaneously decreasing the ability of ecosystems to provide more regular and cleaner suppliers. To avoid crisis, the city must conserve water, pollute less manage, supply and demand, and slow population growth. Again flexible and innovative solutions are needed to cope with sudden and substantial change in water demand for people and their associated economic activities. Assessment of the population growth on pipe-borne water availability in Minna will offer an opportunity in addressing some of the challenges. (Natural and applied science in department of Federal University of Technology Minna).

1.2 Statement of the problem

Water is needed in all sphere life. Water is put into so many uses from domestic to industrial. Through a renewable resource, it is limited in supply at a point in time. In recent years, water availability has been increasingly assuming not only significant, but also threatening proportion especially in the urban area where uncontrolled (indiscriminate) activities bring about immeasurable degrees of water shortage thus contributing substantially to water scarcity in the capital city of Minna (natural and applied science in department of Federal University of Technology Minna).

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It has been observed that Minna is facing pipe-borne water deficit, this trend poses a tremendous concern to both policy makers and consumers. Some studies have show that there is some relationship between the number of people and the availability of freshwater (natural and applied science in department of federal university of technology, Minna). According to GOG (2007) population explosion in Accra has lead to limited supply of potable water provided by the Ghana water company, only few suburbs has access to this pipe-borne water.

Over the years and especially in recent times Minna has witnessed unprecedented growth with its attendant problems occasioned by influx of people from other parts of the state for Administrative, political, economic, educational as well as other purposes, just like most modern areas. Consequent upon the aforementioned it becomes expedient to assess the water resource availability with water management techniques great toward ensuring a sustainable and comfortable urban development (natural and applied science in department of federal university of technology Minna).

1.3 Aim and Objectives

The aim of this study is to assess the population growth in pipe borne water availability in Minna. To achieve this, the following objectives were proposed:-

i. to identify the major causes of pipe borne scarcity in Minna.

ii. to access the extent to which pipe-borne water is used for domestic purposes and make recommendation on urban water provision.

iii. to describe the relationship between population growth and pipe-borne water availability in Minna.

iv. to identify any alternative source of domestic water in Minna.

1.4 Research Hypothesis

i. What could be the causes of pipe-borne water scarcity in Minna?

ii. To what extent is pipe-borne water used for domestic purpose, using the perception in the study area?

iii. It given the present population growth rate can policy makers migrate water scarcity in Minna.

iv. Is there any other water source to meet water demand of Minna

v. Is there any relationship between pipe-borne water availability and population growth

This research is motivated in an attempt to answer the above questions.

1.5 The study Area

The study area is Minna metropolis. Minna city which is both the administrative headquarters of Niger State and the Chanchaga Local Government Area is show on 1.1 the city is estimated with population of 330, 287 (2006 census) people and a land area of about 6,789 square kilometers and is the emirate council headquarters. Minna lies at latitude 9^0 37N- 9^0 79N and longitude 6^0 16E- 6^0 65E on a geological base of undifferentiated basement complex of inanity gueisis and magnetite. To the North of the town, more or less continuous steep outcrop granite occurs limited any urban development in that direction.

The climate of Minna lies within a region described as tropical climate (AW). It has a tropical dry and wet climate. The region is characterized by double rainfall maxims. The tow has a mean annual precipitation of 1300mm the rainy seasons commences most of the time in April and last till October with fluctuation in amount of rainfall received per year. The highest mean monthly rainfall is September with almost 300mm. Temperature is uniformly high throughout the year reaching the peaks of 40^0c February/March) and 30^0c (November/December) except in July and August when the cloud cover prevents direct insulation. The climate supports tall grasses with short scattered tress. These climate characteristics

favour the availability of domestic water to the people during wet season (Minna modern historical book 2003) Google.

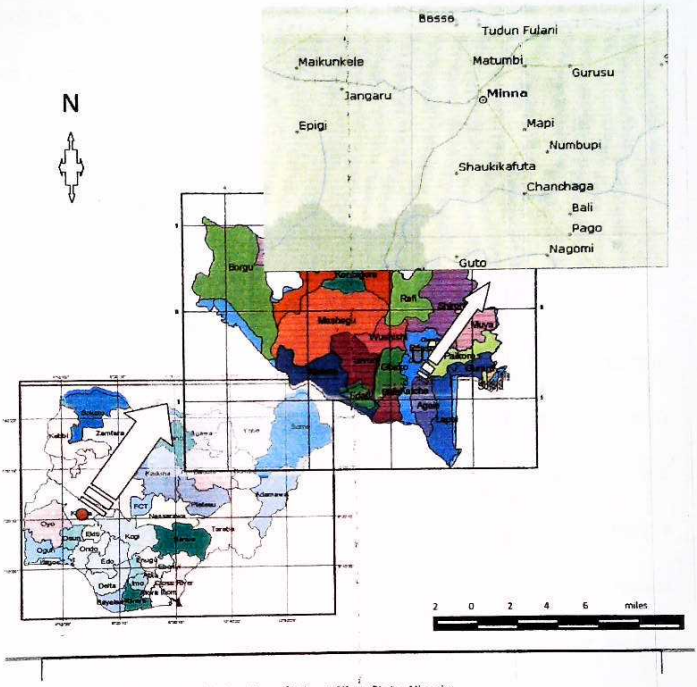

Figure1.1 Location of Minna, Niger State, Nigeria

Source: Adapted from, Oluwa B.A 2011

Field work: 2015

1.6 Justification of Study

Water is universal solvent that is required for living organisms to succeed in life, water is the basic necessity for life, is essentially to food production, to economic development, and to life himself. Water scarcity is among the main problem to be faced by many societies and the world in the 21st century. Water use has been growing at more than twice the rate of population increase in the last century, and although there is no global water scarcity as such, an increasing number of regions are chronically short of water (Human Development Report, 2006 Google.

Water scarcity is both a natural and a human made phenomenon. There is enough freshwater on the planet for six billion people but it is distributed unevenly and too much of it is wasted, polluted and unsustainably managed. There are current more than 430 million people living in countries considered "water stressed". Population Action International (PAI) project that by 2050, the percentage of the world's hydrologist Malin Falkemark estimated that 100 litres (26 gallons) per person per day is the high minimum required for basic household needs such as drinking, bathing, and cooking. She further determined of the agricultural, industrial and energy production sector (Falkenmark & Wid strand 1992).

Applying these bench marks to the data for renewable water by nation, currently 166 million people in 18 countries are suffering from water scarcity, while almost 270 million more in 11 addition countries are considered water stressed (world Resources Institute 1996). PAI estimates that by the year 2050 according to the UN 1996 medium projection, the percentage of the world's population in countries experiencing water stress and scarcity will increase more than five – fold from eight present in 1995 to fifty-two percentage in 050.

This demography pressure has lead one international water resources expert to predict that for these and many other countries, the lack of adequate supplies of renewable freshwater could soon became the main constraint in their economic development (Biswas 1992). This is already the case in several water scare countries in northern and southern Africa, where population growth rates remain high and increased pressure is placed on limited water resources to meet the growing demand for food production.

United Nation projecting that northern 90 percent of population growth between ww and 2050 will occur in developing countries (United Nation population Division 1996), the demand placed in fresh water resource in these countries will make sustainable economic development increasingly difficult (William John, 2003).

Nigeria is one of the countries with her major water body outside it border. Reduction and possibly a total eradication of water shortage in the near further will depend to large extend on the ability to understand the population growth pattern. This is related to the significant of population in water availability.

An understanding of population growth over the years will offer an opportunity to identified what to expect and how to maximize it. Nothing can make this understanding possible other than detailed study and analysis of population and water for this study Minna is chosen by virtue of its importance as one of the areas experiencing water shortage. (Human Development Report 2006 Google).

CHAPTER TWO

LITERATURE REVIEW

2.1 Urban Water Management Policies

Bushaq (2004) studied the implication of water management policies on water poverty in Palestine. To accomplish there objectives a field questionnaire and interviews were developed, the population of the questionnaire was the residents of the west Bank. Interviews were held with persons from west Bank water Department, Palestinian water Authority and Municipalities, the water poverty index was calculated using different approaches, conventional composite index, Holistic; Matrix and WPI Pentagram, Sample Time Analysis, Falkenmark water stress. It was found based on results of field survey that the best approach in estimating water poverty index was the Holistic approach. The estimated water poverty index was WPI = 39.5 percent which indicates that the region faces a serious water problem. To analyze the results of the questionnaire, different statistical techniques were used, these included means, standard deviation, and percentages, one way analysis of variance and Scheffe post HOC test, and independent T-Test.

The main findings of the research were significant differences between males and females in the consumptions of water domain in favoura

of males. Significant differences due to differences in a place of living for consumption of water, health situation, and sanitation service domains in favour of people living in cities. These were due to the fact that still there are some villages not connected to the network and also due to the economic situation for people living in villages and refugee camps (Human Development Report, 2006 Google)

Significant differences were found to exist due to differences in the number of families in the household for the consumption of water and sanitation services domains. No differences were shown for the other domains. It was found that houses of one family consume less water than houses of two and three houses. For sanitation services it was found that houses of one family had better services than houses of two and three families. Significant differences due to differences in family members number for: supply of water consumption of water, health situation, and water quality domains in favour of families of fewer members. Significant differences due to differences in monthly income for: supply of water, sanitation services, and water quality domains in favour of higher monthly income. No significant differences due to water percentage from monthly income for all domains. It was found that 15.4% of the people sampled pay

from 20-40% of their monthly income for water services which is a considerable percentage.

According to the sample surveyed, it was found that the standard of living was distributed according to the following categories as: 8.46.3% of the sample surveyed was of better off category, 9.50.4% of the sample surveyed was of middle category, 10.3.2% of the sample surveyed was worse off category. There was a significant differences between existence of water tank and not for all the domains in favour of houses with water tank. Still there are some regions not connected to safe water and sanitation. As a consequence, water and sanitation related diseases are spread there. About 20% of the sampled members were affected by water related diseases. (Human development Report 2006) from the results of the interview, it was found that the existing tariffs do not encourage water conservation, and are generally inadequate to cover operation and maintenance costs. From the results of the interviews, it was found that the future tariff structure (developed by PWA) did not take into consideration those classes of people who cannot pay for water. Imports of water on one hand could reduce agricultural water and as a consequence could help in alleviating water scarcity (by saving water for other purposes), but on the other hand could have negative impacts on Palestinians economics situation. Low water

prices and subsides for capital investment and operation and maintenance threaten the financial viability of irrigation and water supply.

There are no role for the private sector in the management or expansion of water section services. The existing water allocation mechanisms are characterized as inefficient and not clear as they are a continuation of the system practice before peace negotiation. Clarifying and strengthening water rights can play an important role in improving water allocation equity and efficiency, while a lack of effective waster rights systems creates major problems and in equities for managing increasingly scarce water. Making the water rights tradable may have disadvantages more than benefits under the current situation. Access to safe water is crucial for poor residents. Often women, the poor and disadvantaged groups, including minorities and indigenous people have unequal access to water, which can lead to even greater increases in poverty, privatization of the water sector could help in improving access to water for the poor it privatization is done in a studied way (Human Development Report 2006 Google).

Trade-off among multiple uses of water is possible if practiced under complete control. Under the current situation, no real control over the

complete system can be practiced, so policies and actions regarding water pollution and quality are difficult to implement.

Eastwood (2007) carried out studies on identifying sustainable water supplies: A preliminary Assessment of sustainable water from an urban metabolism perspective. This research followed a two major methodology. Thus in summary the research strategies employed in this study were:

1. Systematic review of related research to bring a more together detail from studies undertaken in isolation into a holistic view for the analysis of the problems. The 'systematic Review' technique is a method for research in the medical area and is beginning to extend into information systems research. Systematic Review is essentially combination of a literature review strategy and 'secondary analysis'. 'Secondary analysis is a process where data gathered by other researchers is then reanalyzed for a research purpose that was distinct from the original research intention. A view taken by secondary analysis researchers is that there already exist an enormous amount of data that had be collected, and that this can form the basis of other works, adding further value to the work that has been done. Given the large amount of existing research that is available, undertaking the same components of data gathering and analysis for new work is replication and introduces the possibility of creating erros (Wikipedia).

2. Development of a framework of analysis based on review of existing material from which to provide a context for determining a sustainable strategy. In this research, data from the following searching areas were employed:-

- A search of Gold Coast City Council ACCC publications
- Using computer based 'key words in text: a search of databases of academic publications.
- Internet searching engines such as Google scholar using similar key words.
- Direct personal communication with various key people to identify the key issues.

Primary data on rainfall levels, water consumption in the city of the Gold Coast, and financial data were obtained directly from a variety of sources. These sources included:

- GCCC website and annual reports
- The reporting tool 'Rainman' purchased from the department of natural Resources.

The results of this research that the restructuring of water use and supply would result in:

- Sufficient water to meet the needs of the population;
- Reduction of waste water and storm water discharged into the environment;
- Savings in energy required by around 270 Gwh per year 2056. Further, location economic and social development would be stimulated, and environmental protection provided, resulting in a plan for the implementation of sustainable development that is consistent with the Johannesburg declaration.

Odunuga (2010) did an analysis of Domestic water use for commercial activities among the poor in Alaju and Sabon Zongo Communities of Accra, Ghana. The research adopted the qualitative method of investigation, for example, interviewing, focus group discussion (FGD) and direct observation. The objectives and research question were explored through collection of primarily data. Data were collected using semi-structured interviews and focus group discussions through interpreters. The targeted population was the study area, taking the sample of both male and female within the age bracket of 20-40 interviews' and focus group discussion were subjected to analyses using statistical package for social sciences (Spss). The study found that income generated from water related businesses contribute either all or more than half of the household income of

water related businesses operator: water prices in the communities are ten times the regulated prices charged by the water utility, which have great impact on the profit margins of these small businesses and are often stronghold of women. The highest of these small businesses and are often stronghold of women. The highest level of education attained by most of the water related business owner is junior secondary school (Grade 8), which gives o basis for explanation of their low level of income and high poverty level. (Human Development Report 2006 Google).

Addo (2010) studied the institutional Analysis of urban water supply in Ghana: the case of Accra metropolitan Assembly. The study focused on the collection of qualitative rather than qualitative data. Thus a narrative descriptive research design was adopted in which non-probability sampling techniques was used to select the study participants. The use of non-probability sampling techniques in qualitative research is on the basis that is provides the ability to access otherwise highly sensitive or difficult to research study population. The study made use of secondary information and primarily data. Secondary information was gleaned from publications, documents archival records in relation to the phenomenon from the libraries of Ghana water company Limited (GWCT) and public utilities Regulatory Commission (PURC) and other available documentations, archival records,

literature and publication. As already indicated, primary data for this study were obtained from in depth interviews with respondents from PURC/GWCL and Consumers of water. In order to obtain the most relevant answers, the study population was directed to the following actors and institutions: Ghana water Company Limited (HWCL); public utilities Regulatory Commission (PURC) and water Consumers (households, industrial, business and agricultural). (Human population Report 2006 Google).

Purposive and show-ball sampling were used to select the sample for this search, the reason was to select cases that were informative and assumed to be familiar with some fundamental issues concerning urban water supply in the Accra metropolis. From the data collected and analyzed the researched found that there was a general lack of interest among actors involved in urban water supply process and non-involvement of some actors in the process. It was also revealed that lack of political will main fasted in lack of continuity of projects of previous governments and diversion of water sector funds for other uses and huge consumption from industries such as Coca cola, Unilever, and Accra Brewery act together to suffocate urban water supply. Additionally, the findings showed that uncontrolled urbanization exists on a massive scale and strangulates efforts to supply

water because it make it difficult for Ghana water Company to map out strategies for service delivery and wean block consumers.

Salendu (2010) studied that quality assessment and interrelations of water and sanitation: a case study of Yogyarkata city, Indonesia, the study made use of two major data; primary and secondary. The primary data collection related to household survey aimed to gather people opinion about how the urban water system works and how do the system interact and dependent on local scale. Questionnaire was undertaken to gather information about the existing condition of water supply, sewage system, septic tank, drainage and also the situation during the disaster, e.g. flooding. The first part of the questionnaire looked at the socio economic characteristics of household which consider household income, education level, house type, the ownership of assests such as land, house, toilet, telephone, electricity connection as well as the supply condition. This part was aimed at identifying the different social classes, the second part of the questionnaire identified the water sources such as private and communal ground water, water from provide, rainwater, surface water, and buying from vendor. The third part of questionnaire included characteristics of sewer system, septic tank, drainage type and also about the performance of each system and other supporting elements other measurements were also carried

but together with the questionnaire survey. Gps points of houses, septic tanks, wells, and kitchens were taken with the purpose of knowing the distance between them in reality. In the sampling design transect sampling method was used in selecting the targeted population. The second stage of sampling was to define sample size for water quality testing. A stratified random sampling was applied in choosing household for test. Secondary data were gathered from the Gadja Mada University, like water pipe networks, sewer line and drainage lines. Some data related to standards of in structure were collected from public work Agency Bureau of planning and development with the parameter of monitoring water quality and standards of drinking water from the Health Agency City of Yogyakarta.

The data collected from the household were inputted into a spread sheet using Microsoft excel. The data were then converted into Spss spread sheet for analysis, from the analysis, the study found the following:

1. A ground water source of water supply was seen to be the main source of water for the people in Yogyakarta city.
2. Contrary to user perception, ground water was found to be more polluted than tap water.
3. Ground water pollution showed high population in dense are along the river.

4. No significant correlation was found between the distance of well to river and total Coli forms observed.

Khatu and Vairavamoorthy (2007), Examined that the challenges for urban water supply and sanitation in the Developing Countries. The study relied on the existing literature of water availability in developing countries. It fund that there is an urgent used for planet action to manage water resources effectively, that the problems in urban areas of developing countries are of particular concern as still large sections of the community are living without safe water supply and basic sanitation services. It was widely acknowledged that in the past several urban water intervention (particularly in developing countries), have failed and this was in part due to little or no attention given to the institutional landscape within which these intervention are applied and the lack of stakeholder involvement in the development and implementation of these interventions, that adequate provision of urban water supply and sanitation was likely to become more difficult in the future due to several change pressures such as urbanization, climate change and infrastructure deterioration.

The study concluded that the challenge was to develop appropriate technical and institutional responses to these pressures that radically change the way in which urban water systems are managed. Interventions must be

considered over the entire urban water cycles, recognizing interactions between the various components of the urban water system. There must also be a rethink of the way water were used and reused and greater use of natural systems for treatment (that are likely to be more effective against emerging contaminants). The objective must be to develop urban water systems that are more robust and resilient against these uncertain future pressures, that to achieve all these appropriate scientific and technological innovations and solution will need to be developed. However, to ensure maximum impact of these innovation and solutions, they must be coupled with components of institutional development (through capacity building activities), and greater stakeholder involvement, that clearly, it is only if there components are included in the solution process can substantially contribute to the reduction in the Vulnerability of cities and capacity and preparedness to cope with global changes.

Wallington, Robinson and Head (2010) studied the institutional capacity for sustainable and integrated urban water management. The approach was an exploratory investigation undertaken into the institutional characteristics associated with changed in water management over the past 20 years or 80. Interviews were constructed with 15 key informants with extensive experiences in water management in South East Queensland

(SED) between December, 2008 and February 2009, participate included staff in senior executive positions across a range of organizations, including the Queensland water Commission (QWC), Department of Natural Resource and water (now the Department of Environment and Resource Management (DERM), SEQ Health waterways partnership, SEQ Council of Mayirs, Local Government, and State-owned retail entities. The interview were recorded and transcribed, and analyzed using file maker pro computer assisted qualitative data analysis software.

The research design and analysis were guided by a conceptual framework for understanding institutional instability and drainage in the water sectors which is detailed in (Wallington and Robinson 2008). Building on institutional organizational theory developed by (SCOH 1995), institutions are understood as structured patterns of practice under ginned by three pillars (www.Google).

1. Cognitive (What people know): Shared understanding or problem framing; which influence the kinds of knowledge and expertise considered legitimate for shaping and addressing the problem;
2. Normative (what people Value): Shared values and norms, which defined roles and responsibilities for actions and

3. Regulative (how social life is organized): the organizational base, or the rules and sanctions that regulate social interaction in pursuit of shared values.

The results of this research agreed with related work, which has identified the capacity of governments industry and community organizations to transfer, translate, and integrate different types of knowledge to inform water policy and management responses as a key challenge (Lane and Robinson, 2009), information sharing between organization and the need for collaborative inter-organizational relationships were also identified as important issue for sustainable urban water governance in Sydney (Van de meene et al, 2009). Building capacities transfer and integrated knowledge promotes technical and organizational learning, contributing to the problem solving and innovation that underpin effective and flexible water systems (Pahlwostl , 2008). Adaptive governance and social learning are considered to be vital ingredient in dealing with abrupt change (Folke et al, 2005).

2.2 Urban Water management Model

Abdo (2009) did an evaluation of urban water supply option using water evaluation and planning (WEAP): the case of Nablus City. The research methodology comprised three main phases. The first phase included data collection mainly from Nablus municipality, water and

Environmental studies institute at An-Najah National University, relevant reports and studies, and information from the internet. Interviews and meetings with the engineers of the Department of water supply and sanitation of Nablus municipality were carried out especially to comprehend the existing situation and to gain an understanding regarding the management plan intended to mitigate the ongoing water related problems. In addition to the above literature review was carried out regarding WEAP and its past applications. As such, reports and journal articles were reviewed, the second phase implied knowledge acquisition on WEAP and its applications, the training manual accompanying WEAP and to get acquainted with the researcher's skills in using WEAP and to get acquainted with WEAP main functionalities. The third phase entailed the development of the conceptual model using WEAP, the conceptual model matched the existing conditions potential scenarios were proposed and were utilized in the research to explored the outcomes the correspond to the different applicable management options. As such, the planning and management alternatives were conceptualized (Adapted from the Department of Water Supply and sanitation of the main capacity of Nablus) and were later processed using WEAP (www.google.com).

The results showed that the unmet water demand will continue to increase over the coming years, this is mainly due to the increase in population with limited water resources. Therefore, securing additional water supplies becomes an essential issue to meet the increase in water demand. The most effective option for the Penvot 2009 – 2025 is the construction of Sabsastia well that leads the lowest unmet water demand during this period. The development of new groundwater well is vey efficient in covering the unmet water demand. In this option the unmet water demand will start to decrease when adding the first well in 2015, and more decrease in 2020, 2025 and 2035 when the second, the third, and the fourth wells are constructed. The decrease in 2025 in the unmet water demand is more than Sabastia well option, so in this period the option becomes more effectives than Sabastia well option. The option of using to run water harvesting gives satisfactory results, in decreasing the unmet water demand be than the option of spring rehabilitations and the reduction in water leakage which gives a small decrease in the unmet water demand. Improving the water related infrastructure of the city to decrease the water leakage in crucial in mitigating the water shortage: (Human Development Report 2007 Google).

Arranz (2006) studied the future water demands and resources in the olifants catchment; South Africa: a Scenario analysis approach using the water Evaluation and planning System 9WEAP) model. Water resources data were obtained from a variety of resources, mainly from the Department of Water Affairs and Forestry 9DWAF). The most important data used were obtained from the WR90 study, which was a national 5 years project undertaken in South Africa to provide baseline hydrological data required for water resources planning and development.

In this study a scenario analysis approach was used in conjunction with the water evaluation and planning 9WEAP) water allocation model in order to assess the impacts of possible future water demands on the water resource of the olifants catchment. WEAP was configured to replicate eight sub-catchments; this configuration was adopted, in preference to the five water management regions used by DWAF, partly because it meant the most important tributaries (the steel port and Blyde Rivers) were stimulated individually and partly because it facilitated model calibration, since five of the sub catchment had flow gauging station located at their outlets, for the eight WEAP sub-catchments, estimates were made of water resources and water abstraction and consumption. The model was tested by comparism of time-series of simulated and observed river flow at the five gauging

stations. For each scenario, the main outputs of the model were analyzed: unmet water demands for the different water sectors, stream flows at the outlet of the Olifants catchment and the water stored in the reservoirs.

The model results showed that for the different 2025 water demand scenarios considered in this study the implementation of the environmental Reserve (an in stream requirement to guarantee the health of the revering ecosystems)) will increase the shortages of other sectors. The construction of the main water storage infrastructure proposed by the Department of Water Affairs and Forestry (DWAF), in conjunction with the application of water conservation and demand management (WC and Din) practice can reduces the unmet demands and shortages to levels lower or similar, depending on the scenario, to those experienced for the q995 water demand baseline. However, in all the cases interventions will not be able to meet completely the demand at all the sectors. A tight control of the growth of the future demand will be needed, although this may be difficult in a rapidly growing developing country like South Africa. Another interesting output of the stimulations performed is that, even the most severe scenario, the mean annual stream flow released to Mozambique (i.e. The country down stream) will exceed 60% of the mean annual naturalized stream flow. This result reflects the inability of the existing storage infrastructure in South

Africa to regulate inter-annual flows (total storage capacity is less than the mean annual naturalized flow) and explain in part the effort of Mozambique to increase the development around the Massigir dam.

Anthony (2003) studied the problem of Water Demand Management (WDM) as a concept and policy. The research applied the methodology of epistemology, which broadly refers to the science of determining truth. In other words what we are being confronted with is the central notion of what is truth (or untruth) to any given statement or conclusion. The analytical paper was consequently about concepts, and in particular about throwing these concepts out for critical discussion and constructive debate. More importantly, the paper was about linking concepts together in an attempt to build a simple model, once a degree of consensus has been reached on the critical definitions of those concepts (Human Development Report Google).

The study shown that a central component of the problem of WDM as a concept and a policy was what have been called the paradox of perception. This in turn is linked to the changing water management paradigm which is shifting in response to external stimuli that are too strong for any one country to resist from an highly centralized water supply perspectives to a decentralized demand management perspective based on the principle of subsidiarity. Underlying this transition as a basic driver

'was the notion of reflexivity, this shift is incremental, which was a healthy condition, as institution need time to adapt. An important element of this adaptive response was what has been called second-order Resources, where it was shown that such resources are an independent variable in the majority of cases. A set of hypotheses has been generated in order to test this nation out, and currently available evidence supports this conclusion (Google)

It was also shown that as a result of the dynamics of complexity, the management of water resources actually consists of a series of oscillations between first and second. Order resources Focal points, which has been likened to the turning of a screw. The important aspect to note however was the fact that complexity increases over time, and that WDM represents yet another layer of management that is super imposed on to an already overburdened set of water management institutions, while the need to manage demand is a manifestation of increased complexity, a new set of complexities are introduced as well, some of which have unintended consequences. The study concluded that a set of seven strategic issue – areas have been isolated. It was hoped that third-party role players and others can use this emerging knowledge in order to select projects where their impact can be maximized. In this regard the role of such third-party role-players is invaluable because they bring with them a degree of

impartiality that increases the chance of success, along with their ability to mobilize the necessary intellectual capital, which improves the prognosis; such efforts are to be encouraged indeed

2.3 Population Pressure on Water Resources

N'Djim and Doumbia studied population and water issue in Mali. They analyzed the population of Mali over period of twenty years. They also analyzed water source for domestic consumption over the same period, population data were collected. Simple percentage was used to calculate the fertility and mortality rate of Mali percentage of population with access to water was found. The study showed that the rate of population growth in male has influence water shortage.

Shannag and Al-Adwan (2006) examined water balances in Jordan. with the view that water is a precious commodity on which human life depends and a limited resource of strategic importance for the coming years. It relies on the finding and conclusions of other studies. The study found the annual rate of increase is 2.5%. Annual renewable water per person (m^3/person per year) was calculated using population of Jordan and water available. The study showed that, the country is classified as water stressed (for example, Cyprus and Egypt) or water abundant (for example, Lebanon and Syria).

Union of Concerned Scientists and Population Action International (1998), they analyzed how demographic pressure has led one international water resources, expert to predict that for these and many other countries, the lack of adequate supplies of renewable fresh water could soon become the main constraint on their economic development. The United Nation Human Development Report (2006) focusing on water, weight in on this too, and add: some privatization programs have produced positive results. But the overall record is not encouraging, from Argentins to Bolivis, and from the Philippians to the United States. The conviction that the private sector offer a "magic bullet" for unleashing the equity and efficiency needed to accelerate progress toward water for all has proven to be misplaced, while those past failure of water concessions do not provide evidence that the private section has no role to play, they do point to the need for greater caution, regulation and a commitment to equity in public private partnerships.

Two specific aspects of water provision in countries with low coverage rates caution against an undue reliance on the private sector.

1. The water sector has many of the characteristics of a natural monopoly. In 'the absence of a strong regulatory capacity to protect the public interest

through the rules on pricing and investment, there are dangers of monopolistic abuse.

2. In countries with high levels of poverty among un-served populations, public finance is a requirement for extended access regardless of whether the provider is public private.

UN-Water thematic initiative (2006) studied coping with water scarcity, a strategic issue and priority for system-wide action. The study relied on population and water available data from various countries. The definition used in framing this programme refers to water scarcity on the supply or quality of water. Under prevailing institutional arrangements to the extent that the demand by all sectors, including the environment, cannot be satisfied fully. Water use has been growing at more than twice the rate of population increase in the last century, and, although there is no global water scarcity as such an increasing number of regions are chronically short of water. By 2025, 1 800 million people will be living in countries or regions with absolute water scarcity, and two-thirds of the world population could be under stress conditions. The situation will be exacerbated as rapidly growing urban areas place heavy pressure on neighboring water resources.

The most vivid example of the interaction of population growth and water scarcity is the vast basin of the Nile River in Northern Eastern Africa.

The 10 countries with territory in the Nile basin contain 40 percent of Africa's population (not all actually within the basin) and make up q0 percent of its landmass, more than 85 percent of the Nile's water comes from the Blue Nile, which originates in Ethiopia (Postel 1992), the vast majority of the river flow, however, is used by Egypt, the last nation in the Nile's paths to the Mediterranean sea.

Ethiopia, for example recently emerged from a long period of civil was and famine into a period of accelerated growth and economic development. The government has overseen the construction of more than 200 small dams that will use nearly 500 million cubic meters of the Nile's flow annually. Additional dams are planned to increase the country's irrigation and hydroper capacity though Ethiopia's current development plans will require only a small portion of the Nile's water, the partial demands could significantly reduce the rivers flow into Egypt. Ethiopia has an estimated 3.7 million hectares of land – an area larger then Belgioum that could be irrigated with a population nearly the size of Egypt's and a faster annual rate of population growth 3.2 percent annually for Ethiopia versus two percent for Egypt Ethiopia will need to develop a large portion of this land for agricultural use (United Nation population Division 1996). Irrigating only help this land area with water from the Nile could reduce the

river's flow to Egypt by 15 percent Gostel 1996). Egypt itself is raising the 'states with ambitions plan for its New Valley land reclamation project,- pressed by population growth within its own borders, the Egypt and government has begun a massive irrigation project in the country's western desert in an attempt to persuade seven million Egyptians to move there from the crowded Nile Valley. When completed, a pipeline will carry up to five billion cubic meters of Nile water from the lake Nasser reservoir to the New Valley site to facilitate the construction of new cities and provide irrigation to more than 200,000 hectares of desert on area more than twice the size of New York city Hydrologists double the basin produces enough renewable fresh water to satisfy the irrigation plans of both Ethiopia and Egypt (Marcus 1997).

Sudan, meanwhile, plan to build its own dam on the Nile North of the capital, Karthoum, where the blue Nile and the white Nile converge before flowing into Egypt (Marcus 1997). The remaining Nile basin countries currently use only a small portion of the river's water. With the cumulative population now numbering over 1.10 million, however, and projected to grow to more than 340 million by the year 2125 it is inevitable that there countries will soon begin to lay claim to a larger share of the Nile's flow to meet their growing irrigation and development needs (United Nations

population Division 1996). In recent years, representatives of the ten nation of the Nile watershed have met to reviews past agreements and consider possible future ones related to their use of this shared natural resources.

The whole word is welding the Nile and similar international watersheds. At a mard, 1997 forum on international water issues in Marrakech, Morocco, UN secretary General Kofi Annan stressed that the project growth of world population over the next 30 years makes developing cooperative international agreements on shared water resources "one of the must urgent issues on the global agents" (United Nations 1997), later that year, the UN Genral Assembly approved a convention to establish guidelines for cooperation on sharing the benefits of international water courses (United Nations 1997). The US State Department and Environmental protection Agency have opened field offices called environmental hubs to help developing nation negotiate trans-boundary solution to regional environmental problems such as fresh water scarcity, deforestation, and air pollution, and to raise the profit of environmental issues in global diplomacy. The Eastern Africa hub which specializes in Nile Basin water resource issues, recently opened in Addu Ababa (Maarcus 1991).

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over time or within a given report of a nation. One example of such a mismatch between available water and the greatest need is in the Southern region of Africa, where Namibia and neighbouring Botswana are engaged in a dispute over use of the Okavango River. On the basic of the amount available per person, Naminia seems to have a relatively abundant freshwater supply. Nambia however, has no perennial rivers, only seasonably flowing ones that are reduced to a trickle several months of the year. Further, Namibia is the driest country in sub-Saharan Africa nearly 83 percent of all rain evaporates soon after it falls, and only one percent of what remains is available to recharge groundwater aquifers (Eales, forster, and Du Mhango

Traditionally, this was not a problem in many regions of Nambia where the mostly rural population would simply move to other water sources during the dry season. Rapid population growth and more densely populated human settlements, however, are hampering this migrating life style. To meet the needs of its growing population, Namibia has in recent years been forced to experiment with a variety of water supply options, including desalination and pumping groundwater from its fossil aquifers. The cost of large-scale desalination has this for proved prohibitive, as Namibia's major population centres are too far inland for water to be pumped economically

from the coast. The desalination plants that do operate require enormous amounts of energy, generating level of pollution that are excessive relative to the volume of fresh water product. Additionally, the over-pumping of groundwater has already led to dangerous increases in salinity as well as the rapid depletion fisheries, increase salinity pollution levels, and lead to a loss of biodiversity in and around rivers, wetlands, and lakes from which water is taken.

With its water needs expected to double within the next 20 years (Eales, Foster, and Dv Mhange 1996) Namibia sees the pipeline as the only feasible solution to keep pace with the water demands of its growing urban centers. Hydrologists now predict that wind hock, Namibia's capital, could begin to run short of water in 1998 (Eales, foster and Du Mhango, 1995). The need for both governments to negotiate a long term solution is clearly urgent.

In conclusion, having reviewed literatures, the research is better informed on the methodologies used in the study area. The research used statistical analysis to gain insight in to water consumers and water analyst officials' perception on the research question raised through primary data, in integration with secondary data from National population and Niger State

water Board. The next chapters explain the methodologies for data acquisition and analyzers.

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CHAPTER THREE

Research Methodology

3.1 Data collection

The Date collection phrase of this project herald the various techniques by which the data used in this work were obtained. In view of this, the data collection phrase has been further divided into two sub phrase;

- .primary Data collection
- .Secondary Data collection

Primary data collection this phrase of the thesis describes the field techniques that used to obtain primary data for the field study in minna metropolis the fieldwork comprise administration of questionnaires to the general public and interview with official's of Niger state water board.

3.2 Administration of Questionnaires and Interviews

The administration of Questionnaires represent the first phrase of collection of primary data the first set of Questionnaires for this study was those administered to generally public the main respondents here were water consumers who make use of pipe- borne water. two hundred copies were administered as follows ; 30 Administered in

Kpakuiyu, 40 in Chanchags 30 in Limiwa , 20 Sabo Gari, 20 Keteren Gwari, 30 Anguwar Sarkin Minna and 20 in Tunga . In the Chanchage more copies of the Questionnaires [40] were administered because of the relatively larger size of the area purposive and random sampling was used to select case that are informative and assumed to be familiar with some fundamental issues concerned urban water supply in Minna Metropolis . At the consumers level purposive sample was used to select one consumers representing household who make use pipe-borne water for domestic purpose . purpose was to choose consumers that adequately represented the characteristic of the study areas and whose experiences with water supply situation may be representative. The Questionnaires were administered on the respondent in their house to establish accuracy to determine the exact origin of data.

In addition to the distribution of Questionnaires to the pipe-borne water consumers, a second category of Question were directed to officials in particular Niger state water board. In total five officials were interviewed. At Niger state water board, the water supply analyst were purposively selected. This is because the analyst as well as the planning engineer are strategically place in the sense that they are

responsible for regulating water tariffs as well as quantity of urban water service delivery. They were this sample for this study and were believed to be capable of providing in depth data that require for the study . the Question were design to be semi- structure since the respondent were allowed to express themselves beyond the limits of the Question [William, 2006] .

The in – depth - interview method offer maximum flexibility to pursue information in whatever direction appears to be appropriate. So the interview process was less structure and researcher allowed the respondent to influence the direction of the interview process. This enable them the opportunity to tell in details their stories with regard to issues of how the population growth influences pipe-borne water availability in Minna. They also share ways the water supply institution can improved and what can be done to actually make this happen.

Secondary data Collection

Secondary information was gleaned from document in relation to the phenomenon from the Nigeria State water Board (NSWB) and National Population Commission (NPC) and available other available documentation on the subject matter. The Niger State Water Board provides data on the

amount of the pipe-borne water distributed to consumer and the water carrying capacity of Chanchaga Dam, the national population commission provided data on population as well as estimated population growth rate of Minna. A personal visit was made to the head offices of NSWB to search for publications.

3.2 Data Analysis

This phase of data analysis made use of statistical packed for social sciences (SPSS). This assisted in the analysis of the Questionnaire, Interview and Questionnaire responses were recorded as required. The data were summarized and categorized into themes. The aim was to provide some coherence and structured to the data while holding on the original accounts and observation, patterns and commonalities in responses were then identified and coded. This allowed for data analysis and identification of common themes to come out with different perception of the population and officials with respect to the various objective of the study. The software was then run to reveal the different trends further discussed in Chapter H. from this analysis it was possible to answer the research questions of

a) What could be the causes of pipe-borne water scarcity in Minna?

b) To what extent is pipe-borne water use for domestic purposes, using the user perception in the study area?

c) If given the present population growth rate can policy maker mitigate water scarcity in Minna?

d) Is there any other water source to meet water demand in Minna.

Analysis of Secondary Data

The research questions were answered through this analysis.

Correlation Analysis or Core Efficient

The method of correlation analysis used was product moment correlation through the use of computer software, SPSS Version 16 to correlate between the water availability and population growth and also to know the strength of relationship.

The correlation is determined by the expression:

$$\frac{[N\sum xy - \sum x \sum y]}{[(N\sum x2 - (\sum x)^2)\,(N\sum y^2 - (\sum y)^2)]^{1/2}}$$

Where:

R = Correlation Coefficient

X = Population Value

Y = Cubic of water available

N = Number of Occurrence

Σ = Summation of Value

Linear regression analysis

The linear regression is attempted to determine how water availability relates to population growth. The relationship between the two variable is visualized by constructing a scattered-gram, the point pattern for the graph determined the form of the relationship between the two variables. The point patterns are better understood by straight line (line of best fit) which summarizes the overall trend in the data and represents the form of relationships between the independent variable and depend variable.

The linear regression is denoted by:

$Y = a + bx$

Where:

y = Cubic of water available

x = Population Value

a = Intercept $(Y - bx)$

B = Slopes $[\frac{(n\sum xy - \sum x \sum y)}{n\sum x^2 - (\sum x)^2}]$

3.3 Research Matrix

The research matrix relates, the data requirements, data sources and methodology that was used in answering the research objective. The dct all is explained on the table below.

CHAPTER FOUR

Results and Discussion

4.1 Description of Result and Discussion

The aim of this study was to assess the population growth on pipe-borne water availability in Minna. To achieve the aim primary and secondary data were collected. This chapter presents the results and discussion obtain after analysis of data source from the field for the convenience of this research work the study was sub-divided into Chanchaga, Tunga, KeterenGwari, Limiwa, Kpakungu, and Anguwa Sarki the 200 questionnaire distributed were completed and returned. The following is the pies entation of the results and discussion of the outcome of the field work.

4.2 Alternative water Sources for Domestic Uses at Chanchaga

The analysis of the respondent, responses to alternative sources of domestic water supply shows the various source used by the respondents to obtain water for domestic uses. The various sources are clearly seen in figure 4.1

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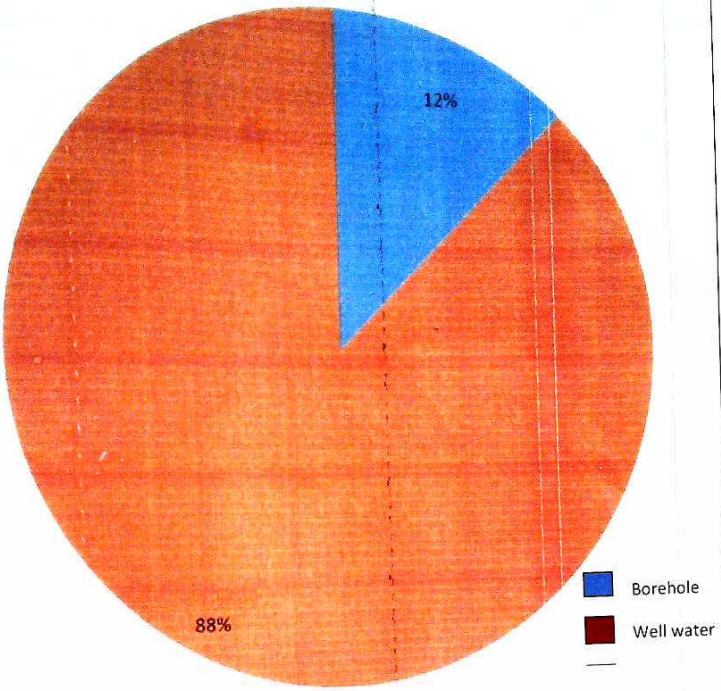

Field work 2015

The figure 4.1 shows that 88% of the respondents make use of well water to complement the pipe-borne water similarly 12% of them make use of borehole as their alternative source for water, the 12% borehole use can be linked with government intervention to solve the problem of pipe-borne water shortage in the study area.

4.1: percentage pipe-borne water use for domestic purpose in Chanchaga.

The analysis of the respondents' responses on pipe-borne water usage for domestic purpose shows various percentages by the respondents as clearly seen in figure 4.1

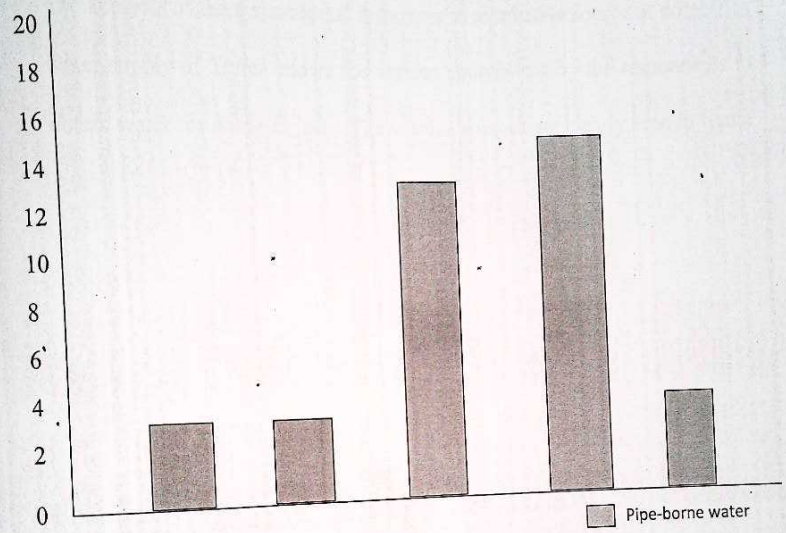

Figure 4.1 field works 2015

Figure 4.1 pipe-borne water use for domestic purpose in Chanchaga form the figure it is see that 16 of the respondents classified the percentage use of pipe-borne water as 15-60% 14 respondents as 41-50%, 4 respondents as 61-70%, while 6 respondents classified pipe-borne water use 40% and

below. The high percentage of pipe-borne water use by this area can best be explained by it closeness to Minna water works.

4.2 Alternative water Sources for Domestic use at Tunga

The analysis of the respondents' responses to alternative source of domestics water supply of Tunga shows the various sources use by the respondents to obtain water for domestic use. The various sources are clearly seen in figure 4.2.

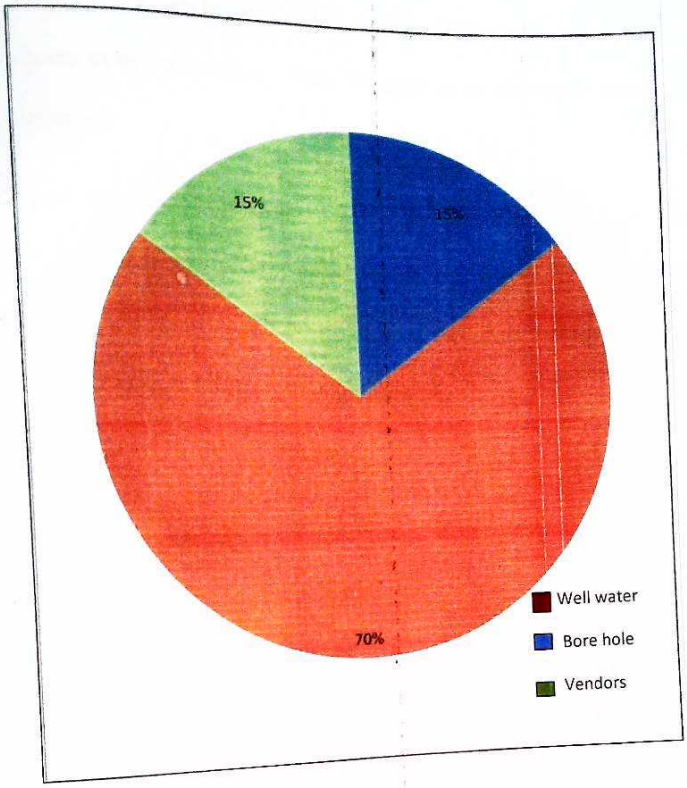

Figure 4.2: Field work 2015

Figure 4.2: Alternative water sources for domestic purposes in Tunga. It is seen from the figure that 70% of the respondents make use of well water as an alternative water source. This represents the highest

percentage in the study area. 15% of the respondents make use of boreholes, as well as water from Vendors as an alternative source of domestic use.

4.2: percentage pipe-borne water use for domestic purposes in Tunga. The analysis of the respondent's responses on pipe-borne water usage for domestic purposes in Tunga shows, various percentage by the respondents. The percentages are clearly shown in figure 4.2.

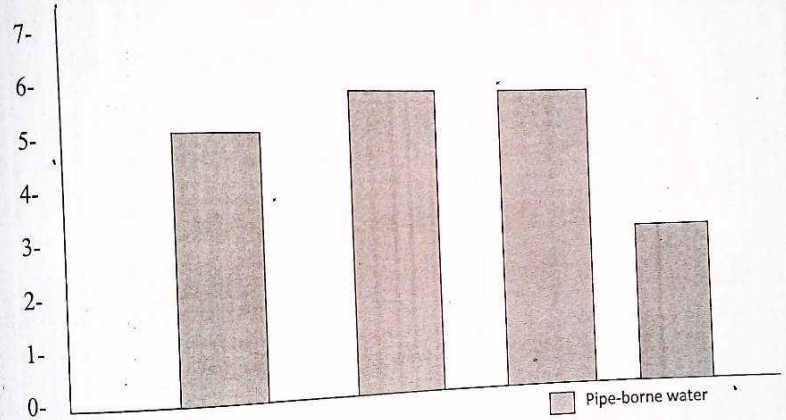

Figure 4.2: Field work 2015

Figure 4.2 percentage pipe-borne water use for domestic purpose in Tunga.

The highest percentage rating of pipe-borne water in Tunga as seen in figure 4.2 is between 31-40% and 41-50% five (5) of the respondents use 21-30%,

while three (3) of them rated pipe-borne water usage above 51% from the analysis, high percentage pipe-borne water usage seen to have a relationship with distance from the Minna water works.

4.3 Alternative water Sources for Domestic use of Kapkungu

The analysis of the respondents' responses to alternative source of domestic water supply of Kpakungu shows the various sources use by the respondents to obtain water for domestic use. The various source are clearly highlight in figure 4.3.

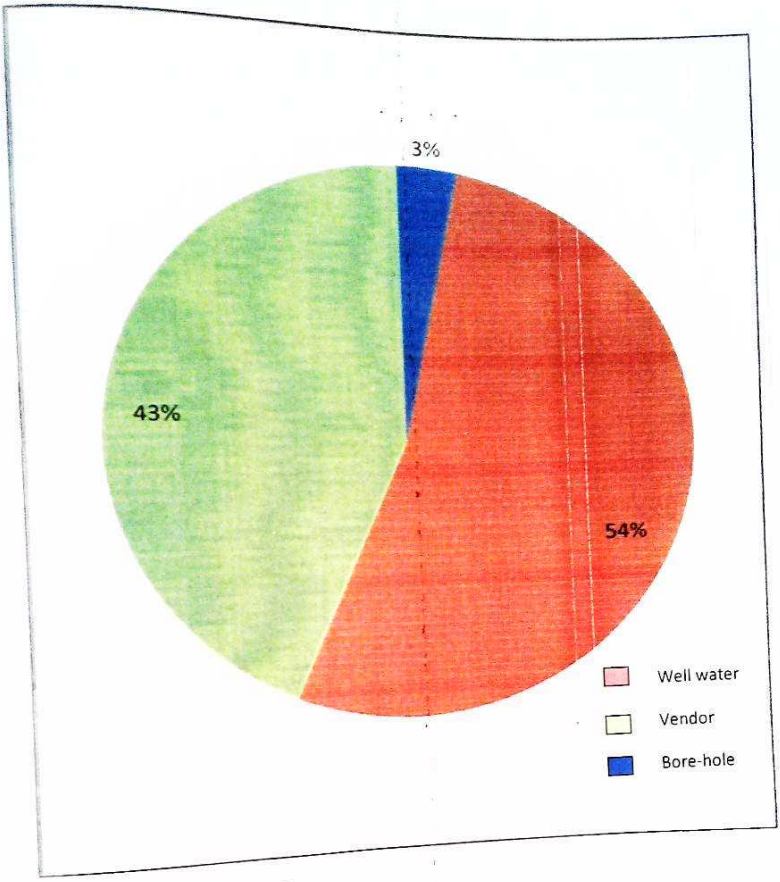

Figure 4.3: Field work 2015

Figure 4.3: Alternative water sources in Kpakungu. The figures reveal that 70% of the respondents in Kpakungu make use of well water as an alternative source of water in the study area. 43% use water from vendors, while only 3% make use of borehole as an alternative source of water.

4.3 percentage pipe-borne water use for domestic purposes in Kpakungu the analysis of the respondent's responses on pipe-borne water usage for domestic purpose in Kpakungu show a high variability in percentage stated by the respondents – the percentages are clearly shown in figure 4:3

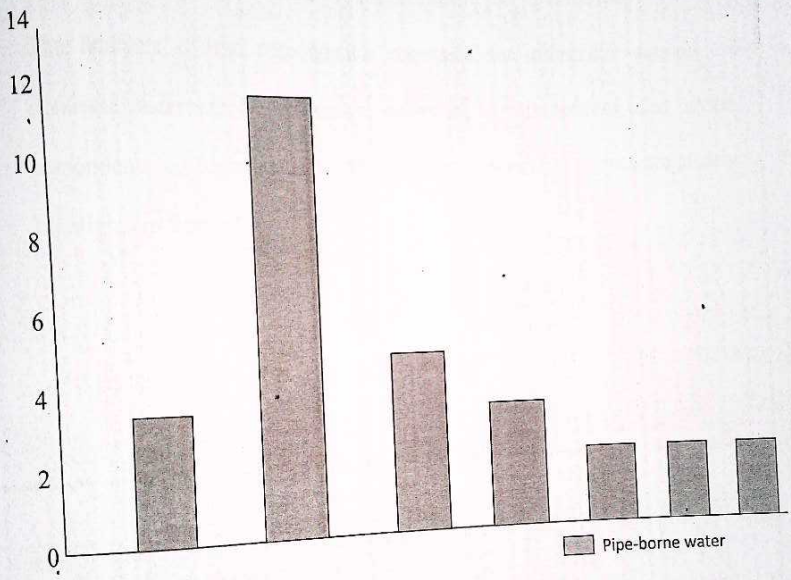

Figure 4.3: Field work 2015

Figure 4.3 percentage pipe-borne water usage in Kpakungu: - It shows that sixteen (16) respondents rated pipe-borne water usage for domestic purposes as it 20%, being the highest in the study area. Five (5) of the respondents rated pipe-borne water use as 21-30%, 4 of them 1-10% 2 of

them respondents put its usage of 41-50%, while a total of it respondents put its usage for domestic purposes above 50%, Kpakungu has the highest variable opinion on the percentage pipe-borne wate use for domestic purposes.

4.3 Alternative water Sources for Domestic use at Limawa

The analysis of the respondent's responses for alternative sources of domestic water supply at Limawa, shows the various sources used by the respondents to obtain water for domestic use, the various sources are clearly highlights in figure 4.4.

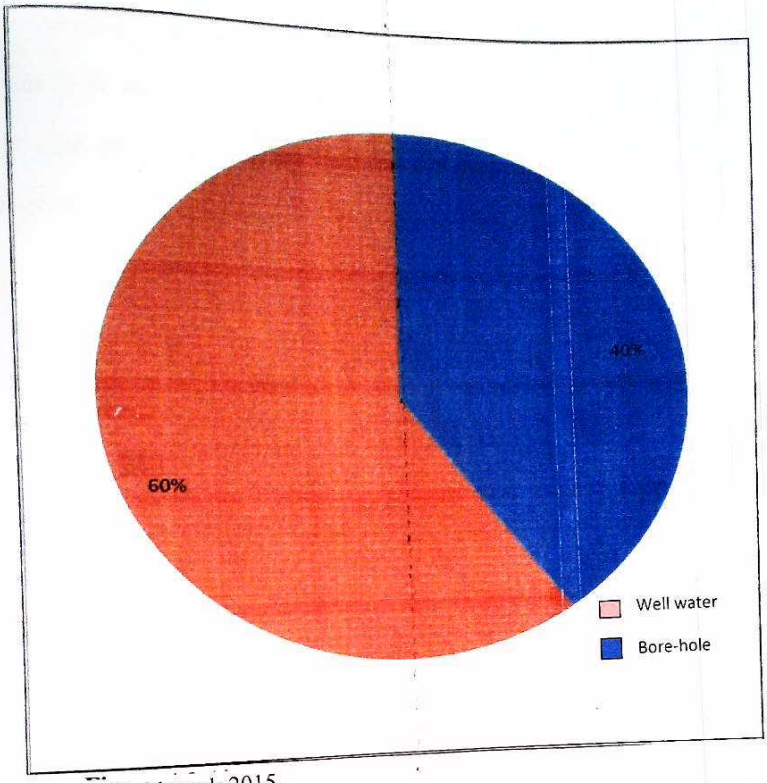

Figure 4.4: Field work 2015

Figure 4.4: Alternative source for domestic purposes in Limawa

The figure shows that 60% of the respondents use well-water as an alternative source while 40% of the respondents use borehole as an alternative sources of water. This is probably one of the area that enjoy government intervention in domestic urban water supply.

4.4 percentage pipe-borne water use for domestic purposes in Limawa the analysis of the respondents, responses on pipe-borne water, usage for domestic purposes in Limawa shows various percentages stated by the respondents. The percentage are clearly shown in figure 4.4

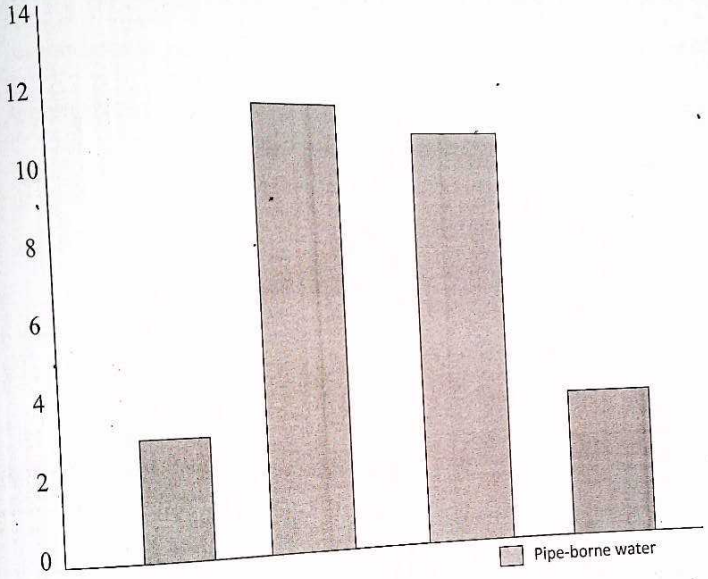

Figure 4.4: Field work 2015 percentage pipe-borne water use for domestic purpose at Limawa.

As show by the figure twelve of the respondents put usage of pipe-borne water for domestic purposes at 21-30%. This is the highest in the study area. 11 of the respondents put its usage at 31-40%, 4 respondents 41-

50%, while only 3 respondents put pipe-borne water usage at 11-20%, from the users perception pipe-borne water use in this are is from 50% and below.

4.5: - Alternative water sources for Domestic use of Keteren Gwari

The analysis of the respondent's responses to alternative sources of domestic water supply at Keteren Gwari shows the various sources use by the respondents to obtain water for domestic use. The various source are clearly highlighted in figure 4.5

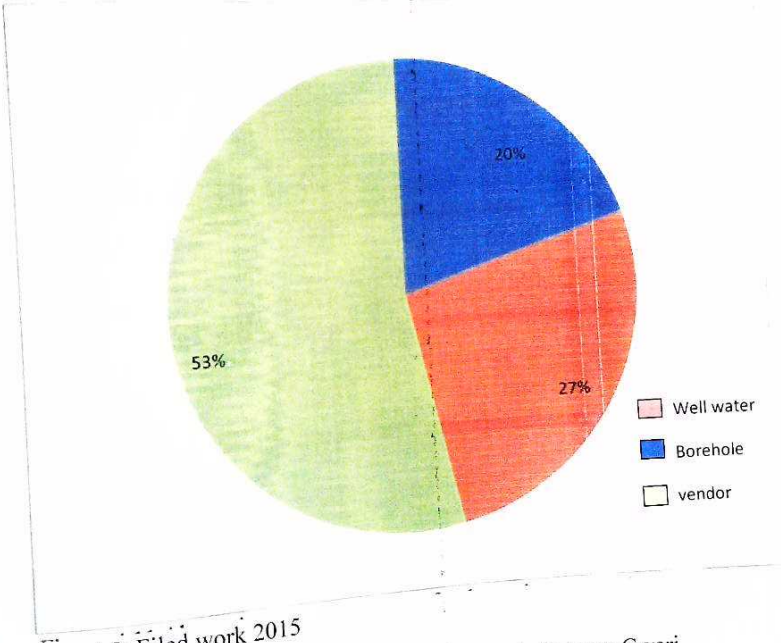

Figure 4.5: Filed work 2015

Alternative water source use for domestic purpose in Keteren Gwari.

It reveals that 53% of the respondents use water from Vendor as an alternative Source of water 27% of the respondents use well water as an alternative source, while 20% makes use of bore-hole as an alternative source of water. This is the only area with water from vendor as the highest alternative source. It is one of the areas that enjoyed stable pipe-borne water in Minna for quite a long time, but due to the dualization of Keteren Gwari road, most of the laid pipes were adversely affected. This probably explains why most people have now resorted in digging of wells.

4.5: - percentage pipe-borne water use for domestic purposes in Keteren Gwari.

The analysis of the respondent's responses on pipe-borne water usage for domestic purposes in Keteren Gwari shows various percentage stated by the respondents. The percentages are clearly shown in figure 4.5.

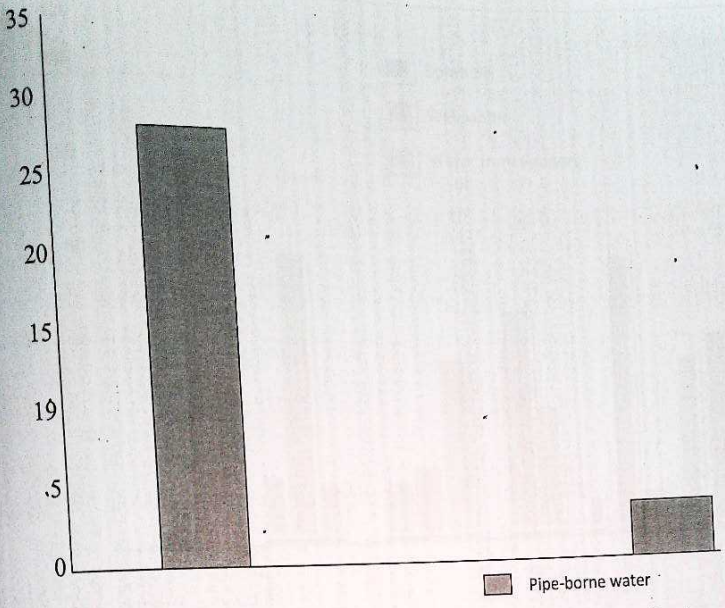

Figure 4.5: Field work 2015 percentage pipe-borne water use for domestic purpose in Keteren Gwari.

It reveal that twenty-nine (29) of the respondent's rated pipe-borne water usage for domestic purposes as 1-10% only one respondent put pipe-borne water usage for domestic purpose at 31.40%.

4.1 Cross tabulation of alternative water source for domestic use in the study area the analysis of the cross tabulation of respondents' responses to alternative source for domestic water in the study are compared the characteristics of the surveyed areas. The various characteristics are clearly revealed in figure 4.1.

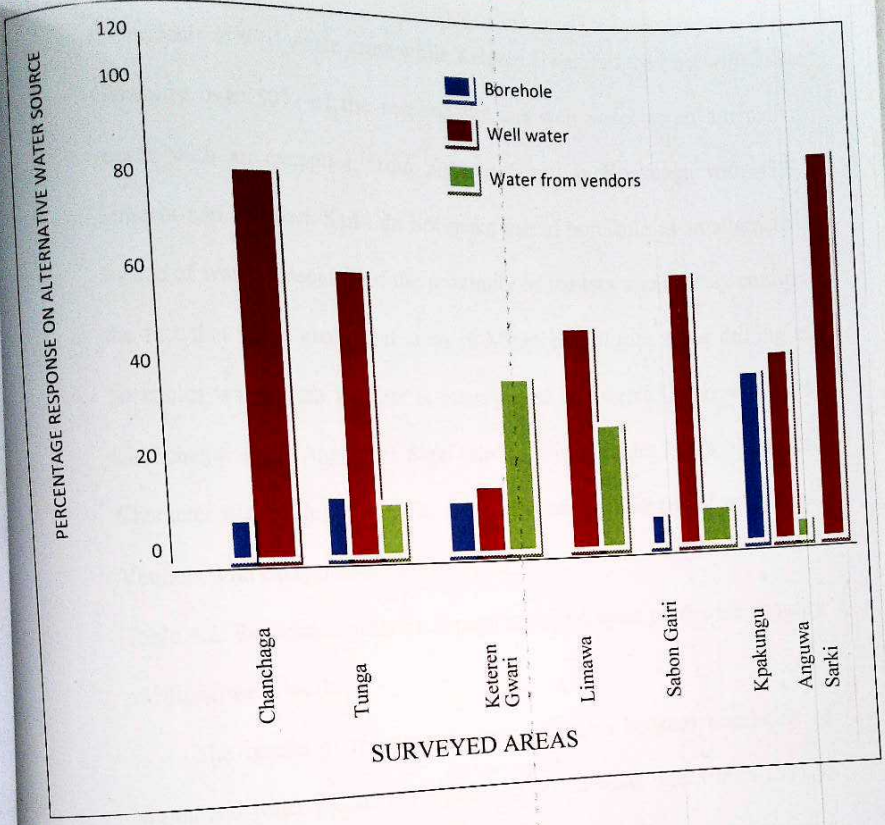

Table 4.1 field work 2015

Figure cross tabulation of alternative water sources for domestic use in the study area. Figure 4.1 above shows that there are variation in the alternative source of water for domestic use in the surveyed area. The well water appear to be the major source of alternative water for domestic use in the surveyed area Anguwa Sarkin with 100% has the highest percentage

respondents of well water users while Keteren Gwari has the least with 27%. Generally over 50% of the respondents use well water as an alternative source with an exception from Keteren Gwari in Kpakungu with 43%. Limawa and Anguwa Sarki do not make use of borelhole as an alternative soruce of water. Because of the proximity of the two areas it may confirm the fact that some geological areas in Minna do not supporting drilling of horeholes water from vendors is mainly used in Keteren Gwari with 53% Chanchaga and Anguwar Sarki do not use water from Vendors. Characteristically, less than 50% of the respondents make use of water from Vendors with exception of keteren Gwari.

Table 4.2: Regression analysis of population and water production capacity of Minna water works.

The results of the plotted linear regression between population of Minna and water production capacity of Minna water works from 1991 to 2010 shows some relationships. The relating are vividly presented in figure 4.2

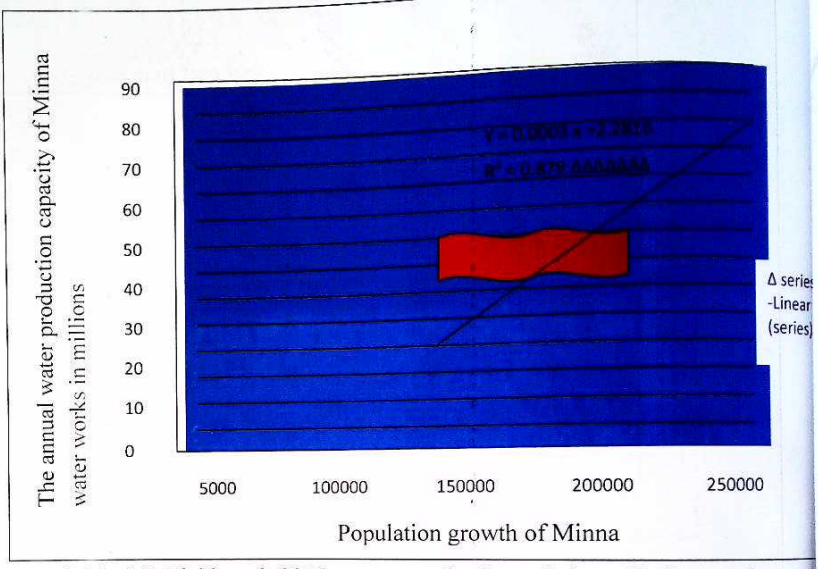

Table 4.2: Field work 2015 scatter graph of population of Minna and water population capacity of Minna works (1991-2010)

In the absence of data for annual water distribution in the study area, the annual water production capacities of the water works and the population growth rate of Minna from 1991 and 2006 census were used. There were no population data of Minna from 2001-2005. The equation shows that, everything being equal, water production capacity of the dam can be estimated. The point pattern indicated that there exists a relationship

between population of Minna and water production capacity of Minna water works, though there are variations for some years. The live of best fit gives a general visual trend of the relationship showing variation from few years.

Table 4.3 Pearson's Correlation Coefficinet between population of Minna and water production capacity of Minna water works. The result of the computed correlation Coefficient between population of Minna and annual water production capacity of Minna works from 1991 to 2o10 is vividly presented in table 4.3.

Table 4.3 Correlation between the population of Minna and water production capacity of Minna water works.

	Population of Minna	Water production of Minna
Population of Minna	Pearson correlation .1	938**
	Sig (2 – tailed	
	N 15	15
Water production of Minna	Pearson correlation .938**	1
	Sig(2-tailed) .000	
Water work	N 15	20

**Correlation is significant at the 0.01 Level (2-tailed) field work 2015

The result shows there exist a strong relationship of 0.938** at a significant level of 0.01. Though there is a strong correlation between the production growth and the water production capacity of the water work, pipe-borne water is still not adequate in Minna. The implication of the result is that, there is an implication in water works but more still needs to be done to meet the water requirements of the study area.

4.4 Analysis of Interview with Niger State Water Board

	Frequency	Percentage
Profession	-	
Engineers	5	100
Total	5	100
Importance of population in decision making		
It Important	4	80
Not Important	1	20
Total	5	100
Major problem facing pipe-borne water availability in Minna		
Inadequate funding	5	100
Total	5	100
Population of Minna and it growth rate		
Has idea of the figure	1	20
No idea but population is Fast Increasing	4	80
Total	5	100
Role play by the Ministry in addressing pipe-borne water shortages		
Drilling of boreholes and distribution of water with tanker	5.	100
Total	5	100

Field work 2015

Table 4.4 reveals that the entire water analysis interviewed in the Niger State Water Board were engineers by profession. 100% of them believe that the major problem of pipe-borne water in the study area is inadequate finding. The inadequate finding was attributed to absolute equipments, insufficient pumps, inefficient funds for new water work and inadequate electricity to power the existing water works. In addition to this the water analysts believe that the population has actually out tripped the capacity of the present water works out of the entire respondents, only one which represents 20% has an idea of the population of Minna and it growth rate. The remaining 80% have no idea of the population but they were all in accord that the population of Minna is fast growing. This probably explains their profession as engineers in relation to demography of the study area. Eighty percent (80%) of the respondents do believe that given the population and its growth rate it will help the ministry in making better decision that would improve water supply in Minna. 20% do not believe population and its growth rate well enhance the ministry's decision making. The respondents were also in accord that the government has intervened in terms of chronic water crisis in years past by measures such as drilling of boreholes and distribution of water with tankers. This explains why 14% of the water consumers use boreholes as their alternative source of water for domestic

use. However, none of the water consumers use fanker water as their alternative source of water. Therefore, water distribution with the use of tanker may probably be viewed as the political statement from the water analysts.

CHAPTER FIVE

SUMMARY, CONCLUSION, FINDINGS AND RECOMMENDATIONS

5.1 Summary

The aim of this study was to assess the influence of population growth in pipe-borne water availability in Minna, Niger State, Nigeria. To achieve this aim, both primary and secondary data were collected, population growth data were collected from National population Commission for a period of 20 years (1991-2020), annual water population data were collected from Niger State wate board for a period of 20 years (1991-2010), structured questionnaire were administered on pipe-borne water consumer in Minna metropolis and interview were conducted using semi-structure questionnaire with water analysts in the Niger State water board. The data were analyzed using Spss. Method such as simple percentage, graph, pearson's correlation and regression analysis were adopted. The results are presented in the previous chapter, the finding of the study are summarized as follows:

- The result reveals that there are three sources of alternative water for domestic use in the study are: Welt-water, borehole and water from Vendors.
- The result reveals that 68% of the respondents use well water, 18% use water from Vendors and 14% use borehole for domestic purposes. The

researcher deduced that the higher percentage of people using well-water was due to its relative affordability in terms of cost. This result challenges the water analyst belief that water tankers are used to support pipe-borne water shortage in the study area.

- The correlation and the regression result indicates that there is a strong relationship of 0.938^{**} between the population growth and water production capacities of Minna water works, though there seems to be improvement in the water production of the water works, pipe-borne water is still inadequate as majority of the pipe-borne water users put its usage for domestic purpose below 50%.
- From the Interview result it was found out that the majority problem affecting the pipe-borne water availability in the study area was inadequate budgetary allocation to the water ministry. This problem was found to culminate in the inability of the ministry to replace the obsolete equipment as well as its inability to embark on new water works. It was further deduced from the interview that pipe-borne water was purely a government affair as all of the respondents believe inadequate budgetary allocation was responsible for water scarcity in Minna.

- The study further revealed that knowledge of population and it growth rate will enhance decision making in ministry of water resources thought this knowledge water found to be inadequate among the water analyst.
- Contrarily to the analyst believe that government intervene at a critical time of water crisis in Minna by the distributing water tanker, the study reveal that none of the water consumer use tanker water as an alternative sources.

5.2 Conclusion

Population growth is indeed a major factor influencing pipe-borne water availability in Minna, Niger State, Nigeria. The Correlation revealed that there is a relationship between the population growth and water availability. Though there is positive Correlation, this relationship seems not to be directly proportional, hence pipe-borne water is utilized below 50% for domestic purposes in the study area. Inadequate budgetary allocation to the ministry of water resources has been identified as the major problem affecting the pipe-borne water availability in Minna, the water analyst interviewed were found to be engineers by professions. Demographic knowledge was therefore inadequate among the water analysts. If these trend continue, the state capital may end up in acute water crisis in the nearest future. Well water, water from Vendors and boreholes has been

identified as the major alternative sources of water in the study area of those three alternative sources water, only borehole water supply is being controlled by the government. The remaining two result from individual households' efforts to meet their domestic water requirements. It is therefore expedient for the authority concern to formulate policies to ensure safety in private water provisions. The water analyst believes governments do intervene in alleviating water scarcity in Minna by distributing water with tankers. The responses from the water consumer show contrarily hence no one uses water from tanker as an alternative source. This implies that some government policies aims at addressing water problems are not fully implemented.

5.2.1 Recommendations

Based on the findings of this study, the following recommendations have been made:

- More resources allocation to the ministry of water resources is highly recommended. This may not be only on budgetary allocation but a policy framework where investors are encouraged to invest in the water sector.
- It is also recommended that a demographic department be created in the 'Niger State Ministry water resources to generate information for water

analyst. This will help in better planning since there is a relationship between water and population.

- Ministry of water resources should formulate and regulate policies on private water provision most especially with respect to well water since this water source form substantial water need of the study area. This will help guarantee the portability of well water source.
- Policy implementation monitoring term need to be enhanced in the ministry of water resources. This is because the respondents seem not to see water from tankers. This will ensure that tanker water meant for the public are actually deliver to them.

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