URBAN MANAGEMENT CHALLENGES FOR WATER SUPPLY IN PERIPHERAL SETTLEMENTS OF KADUNA METROPOLIS

BY

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DECLARATION

I hereby declare that this thesis entitled "Urban Management Challenges for Water Supply in Peripheral Settlements of Kaduna Metropolis" has been undertaken by me in the Department of Urban and Regional Planning under the Supervision of Dr. A. Ahmed and Mr. A. Bello. The information derived from the literature has been duly acknowledged in the text and documented in references. No part of this thesis was previously presented for the award of degree or diploma at any University.

_____	_____	_____
NAME	SIGNATURE	DATE

CERTIFICATION

This thesis entitled "Urban Management Challenges for Water Supply in Peripheral Settlements of Kaduna Metropolis" meets the regulation governing the award of the Degree of masters of Science in Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This work is dedicated to Almighty God for his Love and provisioning which saw me through the entire programme. To my two parents for sacrificing so much for me from the beginning of my academic pursuit.

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ABSTRACT

The need for water cannot be overemphasized as water is crucial for healthy living. Despite this, access to portable water in many urban areas still remain a huge challenge. Giving that attempts are being made to surmount water problems of cities, little is being done to overcome water problems of peripheral settlements. Most studies on water delivery have rather emphasize the urban challenge, combined both core and periphery which has fallen short of reporting the difficulty residents of periphery are faced with in order to meet daily water needs. The research narrows to investigating water supply and demand characteristics resulting to urban management challenges as a result of water supply problems of these areas. Data collection and analysis was conducted in 70% of the identified peripheral settlements of Kaduna metropolis. A sample size of 0.5% of 61,182 household constituted 305 questionnaires, from which only 269 were retrieved for analysis. Results revealed poor access to pipe borne water and over dependence on boreholes and wells, which lacks the capacity of supplying the required water quantity. Attempts to meet needs is responsible for patronage of water vendors with high cost and health implications. The hope to secure pipe borne supply from the metropolis is far-fetched as the KSWB lacks the capacity to meet water demand of the metropolitan core let alone the periphery. To address the water supply shortage of peripheral settlements, there is the need to plan and manage new growth points. Also to ensure that commercial borehole operators are organized to supply water to existing peripheral settlements at regulated price; and the capacities of existing water treatment plants serving the metropolis be increased to cater for the excess population of the core as well as the periphery. Pipe borne supplies to peripheral settlements should commence with those that currently have provision for supply

TABLE OF CONTENTS

Declaration		i
Certification		ii
Dedication		iii
Acknowledgement		iv
Abstract		vii
Table of Contents		vii
List of tables		xi
List of figures		xiii

CHAPTER ONE: BACKGROUND

1.0	Introduction	1
1.1	Statement of Research problem	2
1.2	Aim	4
1.3	Objectives	4
1.4	Scope and Limitation	4
1.5	The study Area	5
1.5.1	The Kaduna Peripheral Settlements	10

CHAPTER TWO: LITERATURE REVIEW

2.0	Concept of Peripheral Settlements	15
2.0.1	Peripheral Settlements	15
2.0.2	Processes of Urban Peripheral Growth	16
2.1	Concept of Urban Management	17

2.2 Relationship between Urban Management and Water Supply 20

2.2.1 Process of Urban Management 21

2.2.1.1 Planning 21

2.2.1.2 Coordination 25

2.2.1.3 Resourcing 26

2.2.1.4 Developing 27

2.2.1.5 Operating 27

2.2.1.6 Maintaining 27

2.3 Urban Management approaches to water supply in peripheral settlements 28

2.3.1 The Mugabi Methodology 29

2.3.2 The Choguil Model 29

2.3.3 The Schiller and Droste Model 30

2.4 Implications of Poor Access to Urban Water Supply 31

2.5 Case Studies of Water Supply Strategies to Peripheral Settlements 33

2.5.1 Water supply in peripheral settlements of Uganda 33

2.5.2 Sida's Strategy for Water supply in peripheral settlements 33

2.5.3 Water Utility partnership (WUP) Strategy for water supply in peripheral Settlements 34

2.6 The Pipe Borne Water Supply Programme of Kaduna Metropolis 39

CHAPTER THREE: RESEARCH METHODOLOGY

3.0 Methodology 40

3.1 Data Required and Sources 40

3.2 Sample Frame 42

3.3 Sample Size 44

3.4 Sampling Methods 44

3.5 Methods of Data Collection 45

3.5.1 Questionnaires Administration 45

3.5.2 Oral Interview 45

3.6 Data Collation, Analysis and Presentation 46

CHAPTER FOUR: CHARACTERISTICS AND PROBLEMS OF WATER SUPPLY IN PERIPHERAL SETTLEMENTS

4.0 Water supply Characteristics and pattern 47

4.1 Sources of Water supply in Peripheral Settlements 47

4.1.1 Pipe borne water supply 49

4.1.2 Borehole water supply 51

4.1.3 Water supply through Dug Wells 55

4.1.4 Rivers and streams 55

4.1.5 Vendors as suppliers of water 55

4.1.6 Time Spent to access water 59

4.2 Demand Characteristics and pattern 59

4.2.1 Pattern of Demand by Households 60

4.2.2 Household Daily Expenditure on water 60

4.2.3 Presence of Queues to fetch water 62

4.3 Problems of Water supply in the peripheral settlements 64

4.3.1 Inadequate Supplies 64

4.3.2 High Expenditure on water 67

4.3.3 Unreliable supply of water supply 69

4.3.4 Inadequate water consumption 70

4.3.5 Time Wastage in accessing Water 70

CHAPTER FIVE: PROSPECTS FOR SUSTAINABLE WATER SUPPLY

5.0 Prospects for Sustainable water supply 71

5.1 Challenges 71

5.1.1 Poor Physical Conditions 71

5.1.2 Poor Management of Metropolitan Growth and Development 71

5.1.3 High Water demand and poor supply pattern 72

5.1.4 Water Suppliers Challenges 73

5.1.5 Environmental Challenges 74

5.2 Opportunities 75

5.2.1 Interest for pipe Borne water supply 75

5.2.2 Regularity of water bill to areas with Pipe borne supply 78

5.2.3 Willingness to pay for pipe borne water supply 78

CHAPTER SIX

6.0 Introduction 79

6.1 Summary of findings 79

6.2 Recommendations 81

6.2.1 Specific Recommendations 81

6.2.2 General Recommendations 83

6.3 Conclusion 84

References 86

Appendix I: Questionnaire 91

LIST OF TABLES

Table 1.0: List of Kaduna peripheral Settlements 10
Table 2.1: The traditional urban management 18
Table 3.1: Data type, description and Sources 41
Table 3.2: Peripheral settlements and detail information 43
Table 3.3: Grouping of peripheral settlements of Kaduna metropolis 44
Table 4.1: Sources of water supply 47
Table 4.2: Pipe borne water duration 51
Table 4.3: Sources of water supply in each peripheral settlements 52
Table 4.4: Borehole Ownership 53
Table 4.5: Borehole ownership in each settlements 53
Table 4.6: Water Vendor patronage 55
Table 4.7: Cross tabulation statistics to find relationship between respondents source of water supply and purchase of water from vendors 56
Table 4.8: Cross tabulation statistics between respondents source of water supply and time spent on queue to fetch water 59
Table 4.9: Quantity of water and money spent by households per day 60
Table 4.10 Price of 20litres of water in each settlements 61
Table 4.11: Time spent in queue 63
Table 4.12: Time spent on queue to fetch water in each settlements 63
Table 4.13: Quantity of water used per household per day 64
Table 4.14: Water Treatment plants in Kaduna metropolis 65
Table 4.15: Family Size 65
Table 4.16: Cross tabulation statistics between respondents family size and quantity of water used daily by a family 66
Table 4.17: Family monthly income 68
Table 4.18: Cross tabulation statistics between family income and quantity of water used daily by a family 68
Table 4.19: Cross tabulation statistics between respondents satisfaction with current

	water supply and sources of water supply	69
Table 5.1:	Indication of interest for pipe borne water supply	76
Table 5.2:	Regularity of water bill	78
Table 5.3:	Willingness to pay for pipe borne water supply	78

LIST OF FIGURES

Fig. 1.0:	Kaduna State in National Context	6
Fig. 1.1:	Map of Kaduna metropolis in the state context	7
Fig. 1.2:	Peripheral Settlements of Kaduna Metropolis	8
Fig. 2.1:	Water Planning Process	22
Fig. 2.2	Development stages in Water supply	31
Fig. 3.1:	Physical location of peripheral settlements of Kaduna Metropolis	43
Fig. 4.1:	Settlements sources of water supply	48
Fig. 4.2:	Pattern of pipe borne water supply in peripheral settlements of Kaduna metropolis	50
Fig. 4.3:	Pattern of water vendor patronage in peripheral settlements	58
Fig. 4.4:	Queues to fetch water	62
Fig. 5.1:	Interest in Pipe Borne water supply	77

CHAPTER ONE

BACKGROUND TO THE STUDY

1.0 INTRODUCTION

Cities worldwide are endowed with basic infrastructure, this advantage creates the pull to cities when compared to other forms of human settlements. The pull to cities creates peripheral settlements which look onto the city for supplies. Cities of the developed countries are better serviced with infrastructure compared to cities in developing countries. Such cities are better because of the organized system of infrastructure planning and delivery, which is conceived at the urban level and infrastructure needs are usually properly identified, then Infrastructure Delivery Plans are prepared in conformity with the proposals of the city plan. In most cases, attention is given to the mother city without much concern to what is happening at the fringe, where new growth points exist. Devas (1993) observed that the core–periphery dichotomy has implications being that the availability of infrastructure and services can influence productivity, health, income and employment. Access to a range of basic infrastructure (e.g. water, sanitation, drainages and roads) is also an indicator of community wellbeing (Solo et al, 1993). Similarly, improving water and sanitation delivery decreases the incidence of illnesses and expenditure on health related matters.

A peripheral settlement is described as the newly urbanized area of the city, which lie on the fringe. Even though they can be seen as a labour market for both formal and informal economies of the city, they are inadequately integrated into the city and have no prioritized basic services like water. Such areas in addition are characterized by uncertain or illegal land tenure, minimal or no infrastructure, low incomes, and lack of formal recognition by governments. Despite being

viewed from the negative perspective, peripheral settlements contribute greatly to overall city functionality, through the supply of affordable land for housing development, urban agriculture, ground rent and payment of development permit charges (Williams et al, 1993).

The importance of water cannot be overemphasized, as it is an important natural resource that is useful in every facet of life. Its quality and quantity affects the health and productivity of humans (Olajide,2011). Much of ill-health which affects humanity especially in the developing countries can be traced to lack of safe and wholesome water supply (Aderigbe et al, 2008). The need to ensure access to portable water to all, is pursued through the global declaration of the Millennium Development Goals (MDGs), which targets to halve the proportion of the population without access to safe drinking water. The target seven of the MDGs set out to improve water supply in rural and urban areas, without acknowledging the situation in peripheral areas, which are neither urban nor rural in nature. While the problem of water in most cities is that of irregularity of pipe borne water supply, the situation in peripheral settlements is predominantly the lack of pipe borne water and overdependence on other sources, often considered to be unsafe and expensive. This then forms the motivation for this study, in order to provide understanding on the nature and challenges of water supply to peripheral settlements.

1.1 STATEMENT OF RESEARCH PROBLEM

The rapid growth of Kaduna metropolis has encouraged the emergence of peripheral settlements many of which are unplanned, lack basic infrastructure and are without planned water supplies. Absence of planned services in the peripheral areas has serious economic and physical implications and is a major problem for municipal authorities to address. Like many urban centres, the attempt to respond to such challenges has not been supported with adequate

knowledge of demand and supply characteristics as most of what exists is not available to the municipal authorities in the detail required for planning. Most attempts to address the problems have also failed for lack of planning data and for being fragmented, informal and uncoordinated.

Water demand and supply analysis at the city level (Maiyaki, 2006; Abdu, 1998; Osagioduwa, 2007 and Nyam, 1999) have received greater emphasis in research than those that disaggregate performance at sub city levels. Granted that such aggregate city level studies are useful, the analysis of the dynamics and challenges at the urban fringe is justified, the argument being that the problems of the city core (where services exist) usually differs from those of the peripheral areas. Such studies can permit better response, in addition to informing the municipal authorities of the specific challenges to address. Recent studies of the urban periphery by Audu (2007) and Habila (2007) have emphasized growth management based on land use planning and development control.

This study examines the problems and prospects for management of water supply to the peripheral areas of Kaduna metropolis. The study fills the gap created by the focus it has on the problems and management challenges of water supply to the peripheral settlements of Kaduna. The questions answered are:

1. What are the water demand and supply characteristics in peripheral settlements of Kaduna metropolis?
2. What are the challenges to water supply to peripheral areas?
3. How should the challenges of water supply in peripheral areas of the metropolis be approached?

1.2 AIM

The aim of this research is to examine the characteristics of water demand and supply in the peripheral settlements of Kaduna metropolis with a view of identifying pattern and challenges, and making recommendations.

1.3 OBJECTIVES

1. To review the relationship between urban management and water supply
2. To examine the pattern of water supply and demand in peripheral settlements of Kaduna metropolis
3. To determine the problems of water supply in peripheral settlements of the metropolis.
4. To determine the urban management challenges for urban water supply in the peripheral areas of Kaduna and make recommendations.

1.4 SCOPE AND LIMITATION

The Scope of this study focus on water supply to peripheral settlements of Kaduna metropolis so as to understand the nature and pattern in which water is supplied. No coverage of the core metropolitan area was made, as the research is only concerned with settlements at the fringe of Kaduna metropolis which serves as home to large number of workforce in Kaduna. The study identifies thirteen peripheral settlements out of which 70% are sampled for this study.

1.5 THE STUDY AREA

Kaduna's peripheral settlements has been undergoing spatial changes as the city moves outward and absorbs previously peripheral settlements. Its width ranges from 6-13Km approximately but this has changed overtime and is almost certain to continue doing so with future urban growth. The zone is not of uniform width around the city but it is most extended along trunk infrastructure arteries. These roads are found in a radiating pattern from the city centre.

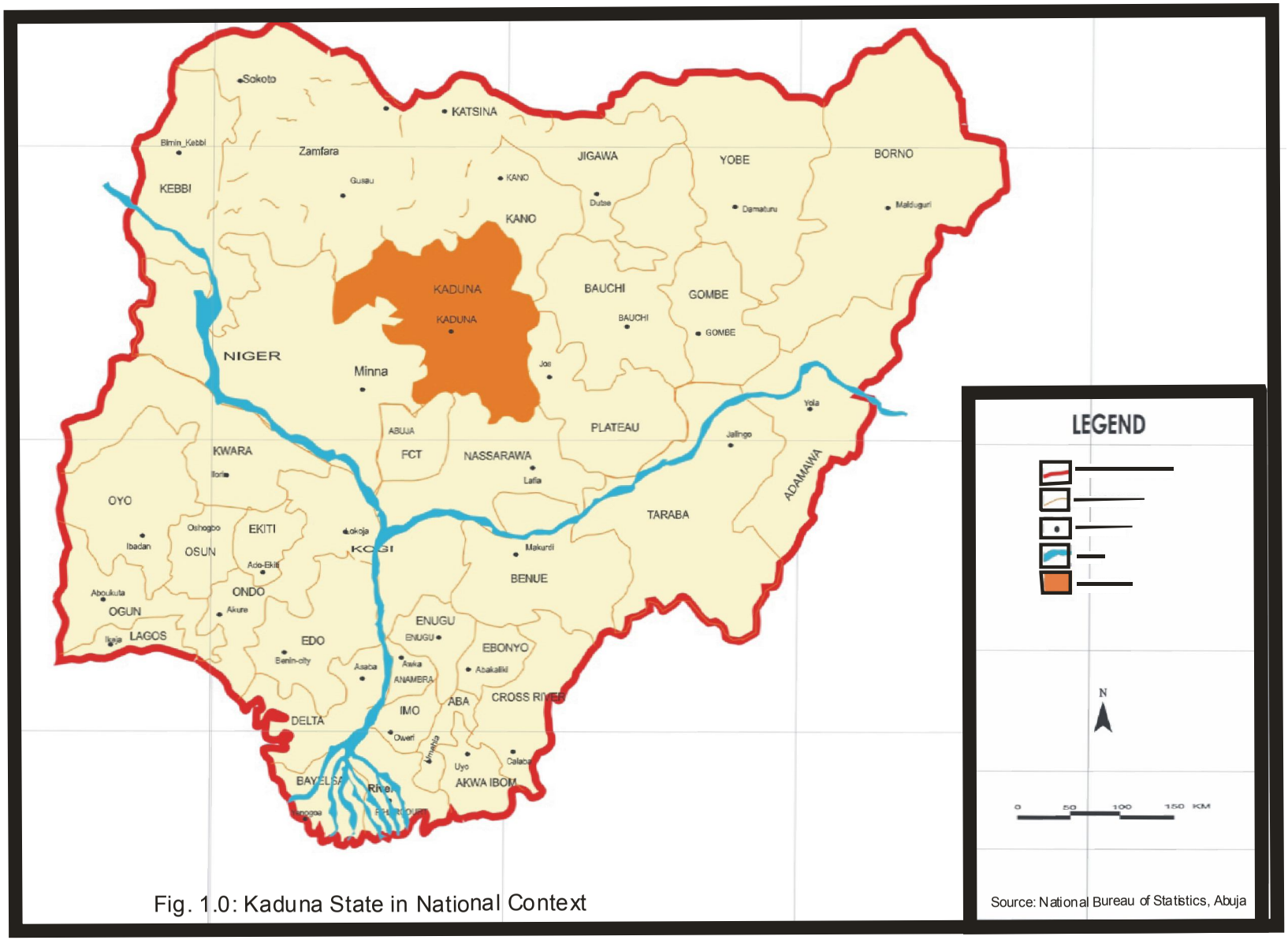


Fig. 1.0: Kaduna State in National Context

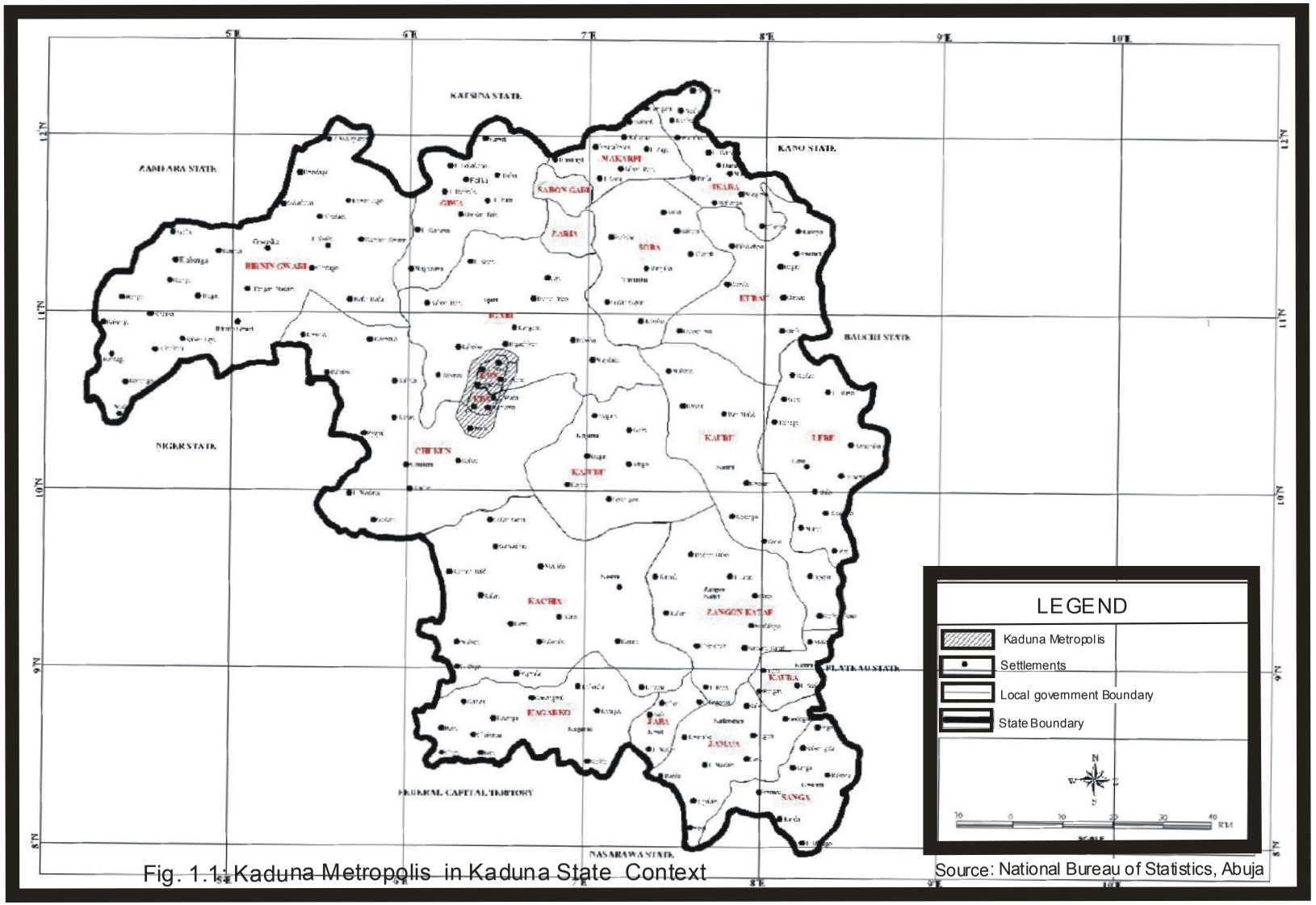
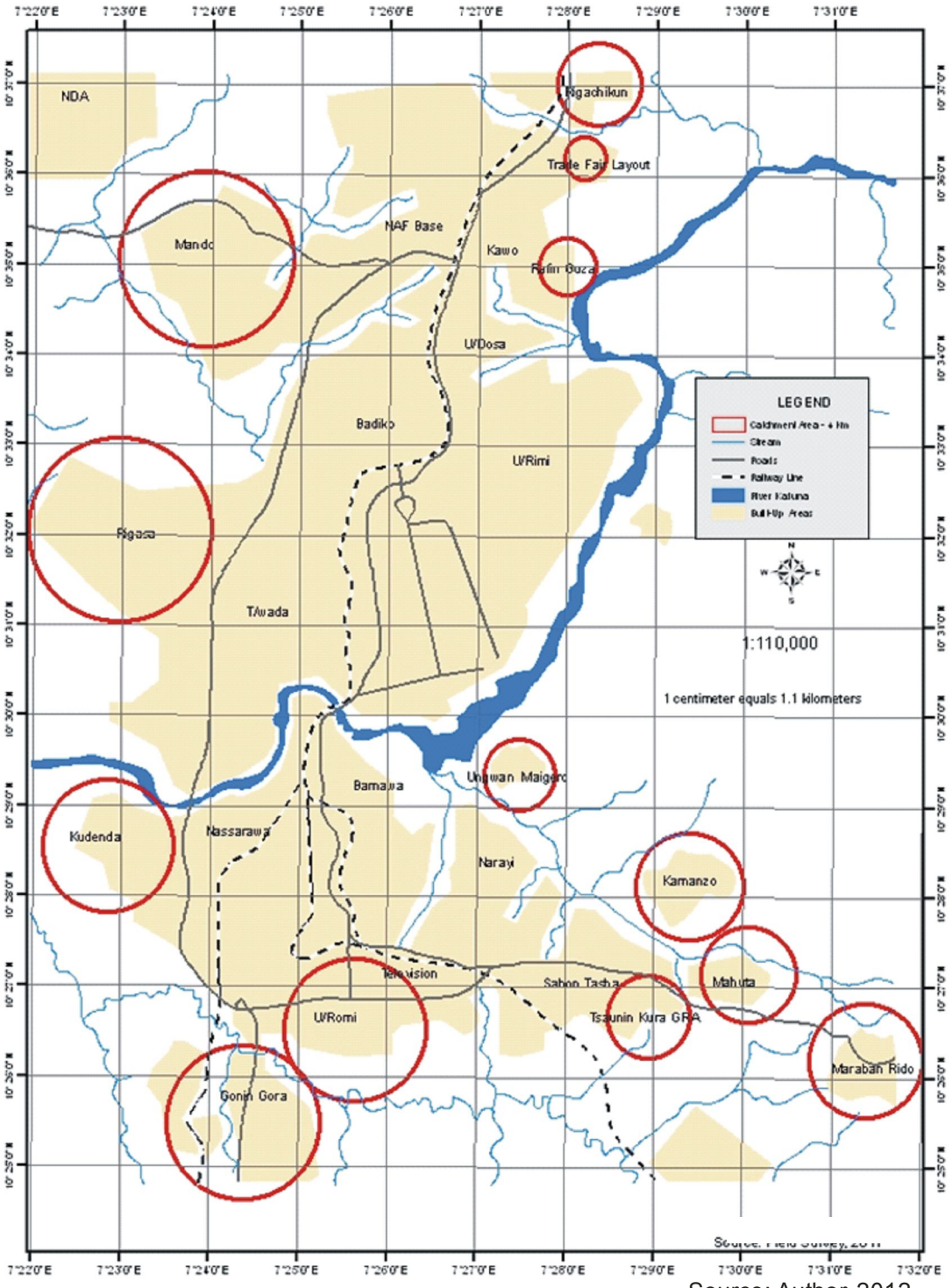


Fig. 1.1: Kaduna Metropolis in Kaduna State Context

Source: National Bureau of Statistics, Abuja



Source: Author, 2012

Fig. 1.2: Peripheral Settlements of Kaduna Metropolis

The development of unplanned urbanization along the major roads of the city from the 1970s to the 1990s has given birth to notable growth of localities in the North, West and South of the city. The growth of the city is hampered in the east by the presence of the river Kaduna which is a strong physical barrier. Most of the localities have grown because of the ever increasing population pressure on the metropolis, due to the presence of affordable accommodation and also as a result of their proximity to the work place of most residents. A large number of peripheral settlements have emerged of recent due to recent history of social upheaval of the metropolis.

The peripheral areas of Kaduna are easily identified by the presence of major road arteries. Towards the north along Zaria road development have occurred up to the new trade fair complex and beyond extending to Rigachukun. In the western direction the establishment of institutions such as the Institute of Water Resources, College of Agriculture, Nigeria Defence Academy permanent site and the Airport have opened up the areas along this route for development. Growth has continued in this direction spreading beyond Mando on the Lagos road.

Along the western bypass from Mando, there are developments around Panteka, the National Eye Centre, Rigasa, and Kudenda which serves as an industrial layout. The sprawl has extended until it intersected with Abuja express way. Development in this direction has spread through the road linking NNPC and east-west to Mararaban Rido. Finally, in the south along Abuja express way, unplanned urban development has reached about 6km from the point of express intersection to Gonin Gora.

Table 1.0: List of Kaduna Peripheral Settlements

S/No	Peripheral Settlement	Number of Houses	Number of Households	Distance from Lugard Hall (Km)
1	Romi	8,979	17,958	10
2	Gonin Gora	8,431	16,862	14.1
3	Kudenda	1,482	2,964	6.5
4	Ungwa Maigero	847	1,694	12.8
5	Mahuta	426	852	27
6	Kamanzo	821	1,642	15
7	Tsaunin Kura	478	956	13.1
8	Mararaban Rido	2,873	5,746	18
9	Mando	5,641	11,282	8
10	Rigasa	7,641	15,282	5.4
11	Trade fair layout	723	1,446	8.2
12	Rafin Guza	207	414	8
13	Rigachukun	2,501	5002	9.1
	Total	**41,072**	**82,144**	

Source: Field Survey, 2012

1.5.1 The Kaduna Peripheral Settlements

These are recently urbanized settlements located at the fringe of the metropolis beyond which there is no continuous development. They are equally identified by the nature of development and physical location in the metropolitan context. No distance yardstick was adopted in defining the peripheral settlements of Kaduna metropolis, but just the fact that they are located at the fringe of the metropolis along entry routes to the metropolis. The identified settlements are shown in table 1 and a brief history of each below:

1. Kudenda

Kudenda is a residential settlement that developed in Chikun local Government area of Kaduna Metropolis. It sprang up as result of Industrial activities in the area, as an alternative residential area for industrial activities. The settlement is said to be over 20 years old. Kudenda is not a planned settlement as the Kaduna Master Plan did not provide for development in Kudenda.

Water supply network was laid in 2005 by the Kaduna State Government, and water only flow through the pipes on the day of commissioning, where it was said to have come from water tank rather than from the city supply source. Since then, public water supply eluded the settlement. Kudenda settlement meets water needs through wells and streams as there is no presence of functioning borehole.

2. Kamanzo

Kamanzo is a new unplanned peripheral settlement that gained prominence within the periods of 1999 to date. It is located in Chikun Local Government Area of Kaduna Metropolis and play host to residential developments. There is no pipe water supply network in Kamanzo, and only three privately owned boreholes exists on non-commercial basis. The residents of these settlements relies on wells and streams for domestic water needs.

3. Tsaunin Kura GRA

Tsaunin Kura GRA is a new planned settlement that is located in Chikun Local Government area of Kaduna Metropolis adjoining Sabon Tasha. This settlement was planned by the Kaduna State Urban Planning and Development Authority and allocated for residential development by the

Kaduna State Ministry of Lands, Surveys and Country Planning. The settlement is serviced by pipe borne water supply from the metropolis supply system.

4. Trade Fair Layout

The Trade Fair Residential Layout is located behind the Kaduna International Trade fair ground in Igabi Local Government Area of Kaduna metropolis. It is a Planned residential area by the Kaduna State Urban Planning and Development Autority (KASUPDA) and allocated for residential development by the Kaduna State Ministry of Lands, Surveys and Country Planning. The area has not witness the laying of pipe borne water supply network and does not receive pipe borne water supply. Privately owned boreholes and wells are currently the sources of water supply in this settlement.

5. Mararaban Rido

Mararaban Rido is a peripheral settlement located along Kachia Road in Chikun Local Government Area of Kaduna State. It is a residential area that received a boost between the periods of 2002 to date. It currently relies on wells and has only one privately owned borehole which caters for water needs of the settlement, as the settlement is not connected to pipe borne water supply network. The settlement is not planned and was not captured by the Kaduna Master Plan, yet KASUPDA undertakes development control activities. Lack of planning of this settlement poses serious challenge for future infrastructure development.

6. Rigachukun

Rigachukun is a peripheral settlement that is located along Zaria in Igabi Local Government Area of Kaduna State. It has been in existence since early 1970's but was not captured by the Kaduna Master Plan and is not a planned settlement. Some parts of the settlement have access to pipe borne water supply network with erratic supply to those areas close to stream as slope favours downward flow. The larger part of the settlement is not connected to water network and does not receive pipe borne water supply. The settlement has 9 boreholes out of which 5 are hand driven and sunk by state and local governments, while 4 are privately owned.

7. Mando

Mando Residential settlement is located in Igabi local government area of Kaduna State along Lagos road. Greater part of the settlement is not connected to pipe borne water supply network, while smaller part is connected but has since 2006 not receive supply through the network. The area is unplanned and grossly lacking in water supply. Where inhabitants rely of wells, streams and boreholes for water supply.

8. Gonin Gora

Gonin Gora is Located along Abuja Road in Chikun Local Government Area of Kaduna State. It is a new settlement that was established in the late 1980's. It was not captured by the Kaduna Master Plan and is therefore unplanned. Residential developments are organically arranged posing challenge to future laying of water supply network. The older part of the settlement closer to the core has water supply network as well as the Federal Housing located in the area. But the greater part to the right along Kaduna – Abuja Express does not have laid pipe borne water network of pipes.

9. Rigasa

Rigasa is one of the closest peripheral settlements to the metropolitan core. It is unplanned and not captured by the master plan. The growth of Rigasa is organic, chaotic and lack planning inputs. Yet evidences of development control activities exists. The lower part of Rigasa closer to city core enjoys erratic pipe borne water supply, but the larger part either has network that last receive water supply through the network six years ago or no network at all. Rigasa presents a sharp challenge where water requirement is met through wells and boreholes and none of the functioning boreholes is sunk by the government. The existing boreholes are privately owned and water is sold to members of the public through water vendors.

CHAPTER TWO

LITERATURE REVIEW

2.0 CONCEPT OF PERIPHERAL SETTLEMENTS

2.0.1 Peripheral settlements

There is no universal definition of peripheral settlements. The Food and Agriculture Organization of the United Nations (FAO), defines it as the connection between rural and urban areas whereas the United Nations Children's Fund, UNICEF and the World Bank see them as newly urbanised areas at the city fringe (Mbiba, 2002). These areas can also be viewed in a much wider remark than just considering their spatial location as areas at the fringe of the city. These areas function change with time and are a natural meeting place for inhabitants from both the city and the countryside. The UK Department for International Development, DFID, defined peripheral settlements as areas with strong influence of the urban context and with great quantity of labour supply, but at the same time influenced by shortages of land, poor infrastructure and urban growth in their Natural Resource System Program, NRSR (McGregor et al, 2006).

In the context of this study a peripheral settlement is defined in a descriptive way as an area where the residents are dependent of the city's economy rather than rural activities. Even though they can be seen as a labour market for both formal and informal economies of the city, they are not prioritized in means of basic services like water. Furthermore these areas are inadequately integrated into the city.

Peripheral settlements are characterized by uncertain or illegal land tenure, minimal or no infrastructure, low incomes, and lack of recognition by formal governments. Families who live in informal settlements build on cheaper land outside city limits, on land within city limits that is not zoned for housing, on land that has not been urbanized with infrastructure, or on land considered dangerous or environmentally fragile.

2.0.2 Processes of Urban Peripheral Growth

The urban periphery is not explicable in terms of its present location within the urban area, but must be referred to the edge of the build-up area at a past period of time. Therefore, its growth can be interpreted in terms of evolutionary stages and their associated processes. There are basically two main phases of development:-

1 Formation Stage

The first phase is when land at the fringe of the built-up area is taken up for the first time by urban land uses. These uses might be due to government policies, preferential location, incidental or most particularly the search for affordable accommodation. At this stage the population is still largely made up of the rural indigenes with a small percentage of migrants both from the inner city and from other smaller settlement and towns. Economic activities are largely agrarian. Planning at this stage is usually minimal or not at all.

2 Modification Stage

At this stage, there is the modification of existing land uses such as change of agricultural land to other uses. Most modifications are attendant upon the changes of location that results from the enveloping of the fringe-belt by the outward growth of the built-up area. The population

gradually changes in constituent proportions between indigene from rural populations and migrants. Economic activities shift from agrarian to service oriented economy. The older the fringe-belt, the greater the relative change.

The fringe-belt zones undergo a continuous evolution, as aptly underlined by Schenk (2002) who draws from Asian experience that they expand and shrink geographically 'eating' their way into the country side. While they are swallowed by the expanding core area, hence this author suggest "the concept of two-fold dynamism in rolling fringe. At this stage the areas become more urban in nature in terms of population and physical characteristics and planning inputs are more pronounced.

2.1 CONCEPT AND SCOPE OF URBAN MANAGEMENT

Urban Management flourished as an institutionalized concept from the mid-1980s when championed by a number of key international donor agencies for the developing world. One of the lead agencies in this respect is the World Bank, whose lessons from its urban investment projects of the early 1970s led to wider systemic approaches in housing, urban land and infrastructure provision. To this was added the need for institutional changes to allow for improved management of new urban investments. Management is a matter of taking sustained responsibility for actions to achieve particular objectives. As such, urban management can direct efforts toward common goals, glean benefits from co-ordination of expenditures and human actions, focus resources on high priority targets, organise and initiate essential tasks which competition, confusion, inertia or neglect leave undone.

Two views explains urban management: First, the traditional view which associates urban management with municipal and central government. This is a largely supply-driven model, whereby the state and its agencies have the statutory responsibilities for management. The provision of services and their maintenance are therefore viewed as rights that citizens expect, partly as a result of the taxes they pay and partly because of the political legitimacy that they give to both the state and local authorities. The table below depicts the traditional urban management model, with a clear public sector orientation and emphasis on physical planning and infrastructure provision. Central and Local Governments are the dominant actors, with non-governmental organizations and international assistance playing limited roles in social sector provision and other emergency relief, perhaps accounting for one-fifth of all management activity.

Table 2.1: The traditional urban management model

Actors	**Responsibilities (management variables)**
Central government	Political and administrative control of local governments
	Provision of grants and loans for all major utility provisions
	Development control and land administration
	Infrastructure development and management
	Preparation and approval of master plans
Local governments	Directly elected or appointed representatives constituting a decision-making body (local government)
Municipalities	Direct provision of social and physical infrastructure
Metropolitan Governments	Maintenance of services and utilities
	Development control; preparation of master and local plans
Non-governmental Sector	Local-level interventions
	Social services provision
	Housing - site and service schemes and upgrading
	Refugees and rehabilitation

Source: Wekwete, 1994

A more recent view of management articulates a broader governance view which brings to fore the role that civil society play and expands the range of stakeholders to include private sector agencies, non-governmental organizations (NGOs), community-based organizations (CBOs) and a variety of interest groups (Mabogunje, 1990). Within the broader governance perspective urban management is more participative, broader in outlook, transparent, and less bureaucratic. Although there are no significant changes in what is being managed, the range and scope of actors significantly has increased depicting the need for good urban management through coordination.

Urban management refers to the political and administrative structures of cities and the major challenges that they face to provide both social and physical infrastructure services. These include managing urban economic resources, particularly land and assets of the built environment, creating employment, and attracting investment in order to improve the quality and quantity of goods and services(Clarke, 1991). It is a set of instruments, activities, tasks and functions that assures that a city functions. That one gets water at home, that roads can transport goods and people, that land is provided for various activities essential for its residents, that public interest is safeguarded against individual and firms interest and that repairs are carried out on infrastructure networks. It ensures that basic urban services are provided for the population and the various private, public and community stakeholders to perform and maximize their intrinsic roles in a harmonic manner. Urban management facilitates coordinated efforts although interest among these actors are not always convergent meaning that conflict resolution is an essential part of urban management. Efficiency, efficacy and equity in the distribution of resources and public investments generated from within the city and to be reverted into further development is the basis of urban management (Acioly, 2003).

Sharma (1989) defines Urban Management as a set of activities which together shape and guide the social, physical and economic development of urban areas. The main concerns of urban management are intervention in diverse areas to promote economic development and wellbeing and to ensure necessary provision of essential services. Urban management is the effort to coordinate and integrate public as well as private actions to tackle the major problems the inhabitants of cities are facing and to make a more competitive, equitable and sustainable city (Van Dijk, 2000). Urban management refers to policies, plans, programs and practices that try to assures population growth is matched with access to infrastructure, housing and employment.

2.2 RELATIONSHIP BETWEEN URBAN MANAGEMENT AND WATER SUPPLY

Urban management ensures coordinated urban development through careful consideration of population and land in which development takes place. Good urban management provides the order and direction of city growth and development through careful planning and provision of basic services necessary for living. It is easy to extend urban water distribution network to planned areas of the city than in unplanned areas. This is because streets are well laid and the population of inhabitants is known. Determining where future growth is directed is a prime driver of water supply planning, and being more certain about the nature, location and rate of growth patterns will help ensure water supply and distribution. The relationship between urban management and water supply is further explained using the processes of urban management as discussed below.

2.2.1 Processes of Urban Management

Mattingly (1995) identified the processes of Urban management, which are discussed below. Every task of urban management requires the performance of basic processes which is common, the processes are: planning, coordinating, resourcing, developing, operating and maintaining. Planning and coordinating what is to be done, resourcing provides what is used, developing provides what needs to be created, operating delivers goods and services, and maintaining sustains the operations.

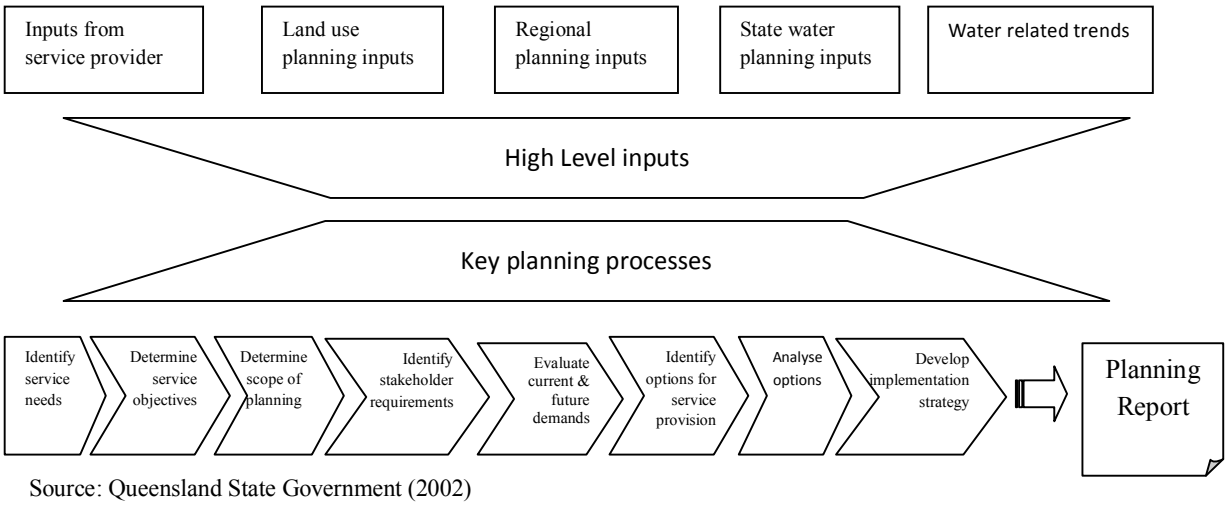
2.2.1.1 Planning

Planning looks to the future with certain objectives in mind, recognises the interrelationships among all matters within the universe of interest (including the relationships among the various acting organisations), identifies present and future problems and opportunities, considers various sets of appropriate actions and recommends the selected action sets. It is most effectively done from a perspective which views all tasks together, encompassing the totality of management activities. In its over-arching position, planning is a process of urban management which gives strategic guidance to on- going activities as well as to growth and basic services provisioning.

Planning is the greatest opportunity to influence project outcomes, minimizes risk and reduce costs in the early stage of an initiative. The cost of planning in comparison to the capital expenditure involved in water supply is minimal. Water supply planning is a continuous process as there is the need to update on the regular basis the provision for water supply in order to reflect population increase. Planning is stimulated by issues such as: changes in unit demands for water supply, variation in growth projections, adverse trends in customer service levels, changes

in community attitudes, changes in technology and changes in regulatory requirements. These changes must be accommodated through continuous planning process with precision to pressing areas. Service providers with a static or declining customer base and limited regulatory requirements for water supply. The planning process may only involve a regular review of: current and future service needs, system capacity and performance to meet the defined service needs, asset maintenance and renewal strategies and the revenue required to sustainably deliver the service (Mattingly, 1995).

The role of planning in water supply is discussed In the processes of planning water supply in figure 2.2.



Source: Queensland State Government (2002)

Figure 2.1: Water planning process

1. Identify Service Needs

In identifying a need, consideration is given to: What exactly is the need? If the need is to provide a service, the provision of new infrastructure may only be one option for providing the service. What evidence exists to support the need and what is the level of confidence that this evidence is accurate and potential solutions to address the need.

2. Determine Service Objectives

It is critical before planning commences to define in measurable terms the objectives and critical success factors of an initiative that will deliver the identified water supply need. These objectives relates to: service requirements and standards; regulatory compliance; operational performance objectives; social objectives; environmental objectives; financial objectives; and workplace health and safety objectives.

3. Determine Scope of Planning

The scope of planning and the resources to be allocated to the activity should correspond to such matters as: the overall importance water supply will provide, the significance of the failure to deliver the service need; the extent of the planning issues to be considered, complexity of the issues to be addressed, risks associated with meeting the service need, costs of a project, potential benefits arising from greater investment in supply.

4. Identify Stakeholder Requirements

An initiative to address water supply need can involve a range of stakeholders in a variety of ways. It is essential to identify the key stakeholders and their desired outcomes at the onset and determine the potential impacts (both positive and negative) and how these can be managed. Some initiatives may require significant consultation with a range of stakeholders. For urban water supply initiatives, stakeholders includes consumers, organisational staff, public and private water supply agencies and individuals. Stakeholders assists in identifying key constraints and deficiencies early in the planning phase.

5. Evaluate Current & Future Demands

This involves assessing the capacity of existing resource, infrastructure and its capability to meeting current and future service demands. It is undertaken in such a way that the population to

be served is known and the approximate per capita consumption is established as basis for determining future present and future demands.

6. Identify Options for Service Provision

Identifying and evaluating feasible options is a critical planning process. These options may be categorized as: base case (do nothing); minimal approach; existing asset options – this may involve asset rehabilitation, renewal or replacement options; non-asset options (e.g. demand management, alternative means of service delivery, reduction, optimizing existing operation or improved utilization of existing infrastructure), new asset options.

7. Undertake Options Analysis

Options analysis can be facilitated through having value management type workshops. Options can be creatively and economically addressed through challenging assumptions, generating alternative ideas, improving communication and establishing priorities. Depending on the scope of the planning, workshops could include internal planning, design, construction and operational staff, a range of key stakeholders or combinations of each. A common problem in the planning process is "optimism bias" – a tendency for planners to be over-optimistic about key project parameters including demand projection assessments, capital costs, operating costs, works duration and benefits delivery.

8. Develop Implementation Strategy

Once the preferred option has been selected an implementation program should be formulated. In formulating an implementation strategy consideration should be given to: staging of the project, service provider implementation targets, implementation targets set by regulators, funding

availability (both internal & external) and this may require input into the service provider's financial model.

9. Outputs from the Planning Process

The output from the planning process will be a Strategic/Master Planning Report, Concept/Feasibility Report or Detailed Planning Report targeted to solving water problems of a particular area.

2.2.1.2 Coordination

Coordinating, is an over-arching tasks and processes, it joins together the actions of several agencies and establishes programmes and budgets. It links various acting organisations in defining overall priority needs and opportunities, in deciding what is to be done and in performing actions in the right sequence at the right place. Actions are ordered in time by programming and matched to likely available resources through budgeting. Coordinating puts great stress upon creating and strengthening lines of communication and increasing the flow of information among institutions. One outstanding function of coordinating is to connect priority concerns of management rather than treat them separately, in order to gain greater efficiency and effectiveness. The complexity of urban situations - and, therefore, of useful responses to problems and opportunities – gives coordination a key role. Actions will inevitably be divided among many organisations and, yet, must be performed in concert for efficient use of resources and for effects to be realised at necessary points in time.

Coordination reduces the waste of duplicated actions in developing and operating urban areas. Moreover, a variety of acts can be ordered and timed so that they are mutually reinforcing, achieving more results for the same efforts and expenditures. In fact, most development and operations essential to good urban management require diverse actions by a multitude of actors, which is impossible for performance without coordination (Mattingly, 1995).

2.2.1.3 Resourcing

Proper resourcing is essential to sustaining the actions which improve urban living conditions and urban productivity. Ways must be found to provide ample resources continuously for as long as a problems exist or an opportunity is not fully exploited. Beyond the needs of new problems and opportunities, resources must be continuously available for operating existing services and for maintaining the facilities and institutions utilised. The major resources required for urban management are human, financial, material, institutional, and informational. The skills and capacities of human resources are to be found not only in government but in the private and community sectors. Sources of finance are similarly in all three sectors. Land available to the three sectors is the most important material resource, but facilities, equipment and materials are also of concern. Important institutional resources encompass organisations in the three sectors, their frameworks of formal relationships and legislation which grants powers to organisations. These include powers to buy and sell, to tax, to borrow money and to utilise generated revenues. Institutional resources also include powers to regulate such matters as land use, building construction, public-vehicle operation and water tariffs. Information may be the only significant resource which some actors can contribute to the urban management process (Mattingly, 1995).

2.2.1.4 Developing

As a process of management, it creates institutions of the government, private and community sector, pools of equipment and facilities such as schools, roads and water mains which are necessary to provide services. It also can create capital goods, such as housing units which go directly to users among the urban populations as the result of a managed service. Development has two aspects: the first is the direct execution of construction works by public-sector authorities and the second is the guidance of private-sector activities to meet urban needs in accordance with a long-term strategy. Therefore the management process must encompass both sets of actions in a coherent way (Mattingly, 1995).

2.2.1.5 Operating

Operation is the day-to-day activities of urban management which deliver services to the public. In this process, governments supply water, collect refuse, light streets, treat sewage and so on. Operating requires the ability to command resources of staff, money, equipment and materials in adequate amounts and appropriate qualities for the tasks to be performed. Therefore, municipal operations is characterised by disruptions in services resulting from technical breakdowns, inadequacies in relation to demand, failure to operate some key services in particular neighbourhoods and low quality in general of the services provided (Mattingly, 1995).

2.2.1.6 Maintaining

Maintenance of urban facilities now attracts considerable concern, although in the past, it has been greatly overlooked in the pursuit of capital-facility development because the results of its absence are not felt immediately. It requires the foresight of management and the discipline of

regular action and outlay of resources to be effective. The continuity of attention it demands calls for permanently available staff with very different skills from those in the capital-development process. It requires administrative attitudes derived from lessons of experience which have not yet been abundant in the histories of many developing countries. Proper maintenance conserves facilities and organisations as reusable resources. This reduces the call on other resources and therefore, can be important to sustaining improvements in urban conditions. Given that so many public facilities have been constructed with funds from many sources and that attempts at cost recovery, where appropriate, have generally failed, maintenance of these facilities would be absolutely essential if the benefits they bring are to be sustained. Programmes to enhance the capabilities of government institutions have not effectively dealt with the steady movement of skilled staff out of public service. This is a major obstacle to establishing sustainable urban management which in turn, can produce sustainable improvements in urban living conditions and production (Mattingly, 1995).

2.3 URBAN MANAGEMENT MODELS FOR SUSTAINABLE URBAN WATER SUPPLY

There is a range of urban management approaches found in the literature. Some are more concrete models and terms of references for planning water supply. Yet others are frameworks that can be seen as an approach for viewing the structure of the issue in a holistic way. They include:

2.3.1 The Mugabi Methodology

Mugabi et al. (2007) propose a strategic planning methodology for urban water utilities in developing countries through strategic planning. Strategic planning is a methodology for thinking in a long-term perspective and planning towards a common goal. The authors argue that some of the biggest challenges are to improve utilities efficiencies mainly by reducing the loss of water, reducing the population unaccounted for water and extend the water service to the poorest households. Important questions answered by this approached included: *Where is the utility now? Where does the utility want to be? How will the utility get there? How does the utility ensure* success?

A performance and practice audit was conducted to identifying the existing situation as well as an institutional analysis for current laws, controls and stakeholder responsibilities. The targets must be precise as possible and be measurable and time bound. The last two questions concern how to reach these visions by specific actions and how successful monitoring and evaluation should be produced. The actions should favourably be as precise as the targets and cover aspects of organizational structure, management information systems, operation, maintenance and financial management.

2.3.2 The Choguill model

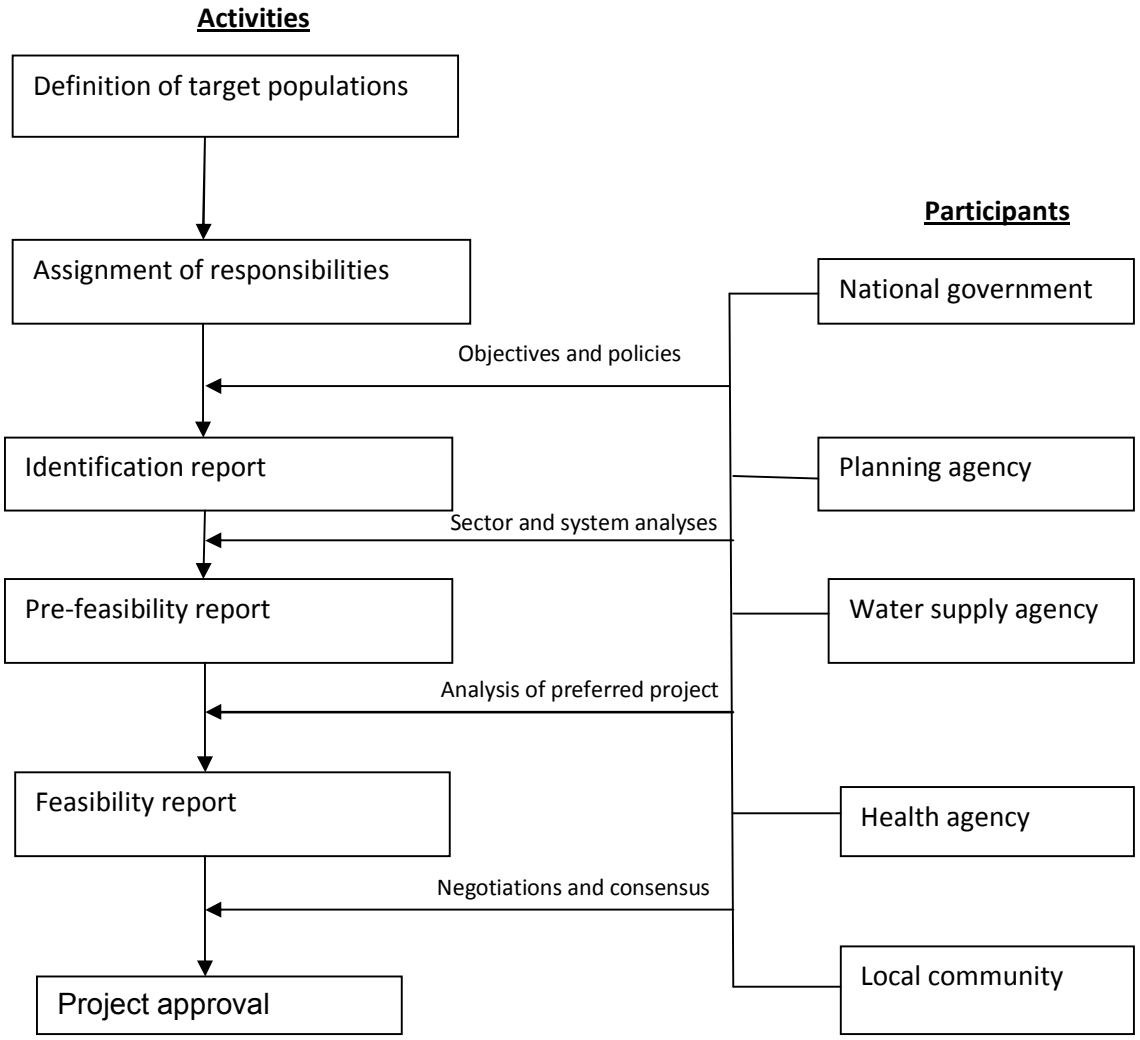
Choguill (1996) Developed model for sustainable water supply for urban areas, where water supply is stressed as important issue. The model is based on the idea that decision-making should be decentralized and mainly in the hands of local communities for gaining success. The target group is not explicitly mentioned but can be supposed to be the public sector. The model

provides certain principles for water supply which includes: Emphasis on the existence of both formal and informal sectors within a city; water supply must be on a cost-recovery basis i.e. the users should cover the cost for the service. When there is a low-income population that cannot afford the cost it can be suggestible to use a cross-subsidy programme; Questions about irregular land tenure must be solved, if the future is unclear, there are no incitements for investments or improvement of one's livelihood in areas considered illegal; the informal settlements infrastructure should be upgraded, either one step at a time or all at once, so that it eventually can be integrated to the city's service system; The local community must be involved in the planning process and be in control of its own infrastructure services and improvements; and water supply must be affordable for the poor.

2.3.3 The Schiller & Droste model

Schiller and Droste (1982) developed a model planning process for water supply in the developing world, with starting point from the World Bank's recommendations of project preparations. The target group of users of the model is the planners of water supply but as one can see there are different co-participants at different stages in the process.

An initial step for the planning phase is to identify the target population. It is also central to study and understand the target group's current water supply system to be able to decide whether it is an option to upgrade the inadequate systems. There are many institutions that should be involved and interact with each other in the process because of its great complexity. Important associations are the national government, the planning agency, the water supply agency, the health agency and the local community.



Source: Schiller & Droste model (1989)

Figure 2.2: Development stages in Water supply Projects

2.4 IMPLICATIONS OF POOR ACCESS TO URBAN WATER SUPPLY

Water is a precious natural resource, vital for life, development and the environment. It can be a matter of life and death, depending on how it occurs and how it is managed. When it is too much or too little, it can bring destruction, misery or death. Approximately 1.1 billion people worldwide lack adequate water provision (WHO and UNICEF, 2000). Unsafe or inadequate

water has been attributed to 80 percent of illnesses and 30 percent of deaths in developing countries (Elhance, 1999). A research outcome revealed that 2.2 million people die of water-related illnesses each year (UNICEF, 2000).

Poor access to water supply has implications in many aspects of human life.. A link was identified to exist between much of ill-health of human to lack of safe water supply, that is easily accessible, adequate in quantity and free from contamination in (United Nation report 2004). When water supply is inadequate, health problems are imminent (Batemen etat, 1998). Fadere and Olawuni (2008) asserted that water supply should be as close as possible to the point of use in order to maximize health benefits of water supply. poor water supply leads to low sanitary conditions, which in turn causes health risks. Osinusi and Oyejide (1989) in Ibadan suggested that shortage to water is a factor responsible for common illnesses in children ranging from 0- 5 years of age.

Poor water supply similarly creates economic implication. The UN water/Africa 2004) asserted that water can be an instrument for poverty alleviation lifting people out of degradation of having to live without access to safe water and sanitation while at the same time bringing prosperity to all. However, when water is inadequate in quality and quantity, it can be a limiting factor in poverty alleviation and economic productivity, food insecurity and constrained economic development. The interdependence between water availability and development is exemplified by the link between water and poverty. Due to poverty, access to adequate water is low in Africa. As a result of inadequate access to water there is a high incidence of communicable diseases that reduce vitality and economic productivity on the continent. Inadequate access to water and

sanitation is thus both a cause and a consequence of poverty. Similarly, inadequate water resources can become a constraint to improved agricultural development and food security.

2.5 CASE STUDIES OF WATER SUPPLY STRATEGIES TO PERIPHERAL SETTLEMENTS

2.5.1 Water supply in Peripheral settlements of Uganda

The usual approach is to identify the current sources of water supply, through inventory to capture all publicly available water sources. Also to establish the adequacy of existing sources, as well as pattern of development. The Ugandan experience centers on development of low-cost approaches to water supply, where a study of ten selected settlements was undertaken. All the settlements were identified to have provision for pipe borne water supply with approval for one tap point in a house or yard (Howard and Luyima, 1999). Boreholes were provided at strategic locations to complement inadequate supplies of pipe borne water. Cost recovery is achieved through uniform charge to all houses with pipe borne water supply.

2.5.2 Sida's Strategy for Water supply in peripheral settlements

Sida's Strategy for Water Supply is supported by a strong decision making process for water supply in the developing countries. Their main motive for supporting these issues is the improvement of livelihood of the poor that come into towns with a change in water supply situation (SIDA, 2004). The focus is on certain key areas with water supply promotion in urban and peri-urban areas. Sida's strategy puts forth approaches that should be considered when making investments in the area of water supply. These are of social, economic, environmental, technical, financial and institutional views. Some of the most relevant principles named in the report are: Water supply should be considered at the same time in the social, spatial and

environmental planning in peripheral and urban areas; Users should be participate in the planning, implementation, management and monitoring procedures of Water Supply systems; There should be a possibility for rural and peri-urban communities to access loan financing from banks and other institutions for improving water supply; The delivery of these services should reach the slum areas which the city is responsible for.

2.5.3 Water Utility Partnership (WUP) Strategy for water supply in peripheral settlements

The WUP Capacity Building in Africa was established by the Union of African Water Suppliers (UAWS) and its partners, with a view to building the capacity of utilities to improve water supply. In order to fulfill this mandate, WUP established a series of targeted initiatives including Project no. 5 (better known as WUP 5) entitled 'Strengthening the Capacity of Utilities to Deliver Water and Sanitation Services, Environmental Health and Hygiene Education to Low-income Urban Communities'. The project was funded by the European Commission and managed by the Water and Sanitation Program – Africa.

In 1998, the WUP 5 project set out to determine how low-income communities were being served. By drawing on the knowledge and unique experiences of utilities, NGOs, small-scale providers and community organizations, the project aimed to develop a better understanding of the key principles underlying 'good practices' – those policies and practices that have contributed to improvements in the water and sanitation services delivered to low-income communities. The knowledge and experience of a range of actors involved in delivering or

supporting these services in Côte d'Ivoire, Ethiopia, Ghana, Malawi, Mali, Nigeria, Senegal, Tanzania and Zambia created the foundation for this document.

Working on the premise that all households have access to some form of water supply and sanitation service - be it different levels of service, delivered by different actors, from different water sources - WUP 5 organized a series of country consultations that brought together a wide range of stakeholders (including utilities, municipalities, line ministries, small-scale providers, NGOs and consumer representatives) to deliberate over critical issues and identify the key challenges of service delivery to the poor. As a part of this consultative process, stakeholders also identified those ongoing initiatives in the region that had improved service delivery to low-income communities. These practices were then documented thoroughly in a set of detailed country case studies each of which set out about thirty six practices and addressed different aspects of water supply service delivery ranging from policy development to water reselling.
Information gathered through these case studies was then used to compile 'good practice' document and to establish a web-based toolkit that provides utilities and other actors with access to information, materials and tools to facilitate their efforts to improve service delivery to low-income communities.

The majority of households without access to a household connection are those living in informal settlements – and the majority of these are low-income. In Dar es Salaam, Lusaka and Blantyre, an estimated 70% of the city is informal and in Nairobi it is estimated that 55% of the population reside in informal settlements that lack adequate network infrastructure. In order to access the

services they need, many of the non-poor have taken their own initiative, extending pipe work for several kilometers to a single dwelling, or combining efforts for mutual benefit. However for the poorest households, the problem is more difficult to solve. It is unlikely that they can afford the options currently open to them and it is likely that a number of other constraints will stand in their way (Foster, 2001).

The first step in a strategy to improve access to private connections should be to facilitate the extension of network infrastructure into those informal or unplanned areas that are currently without network services. The two primary arguments against network extensions are the illegal status and haphazard layout of many low-income settlements that have evolved without formal planning.

Many service providers, both private and public, justify the lack of service delivery in informal areas because settlement took place illegally or in a haphazard manner and may not then have been recognized. They argue that the lack of secure tenure or lack of compliance with building codes and standards makes any intervention in these areas problematic and risky. Unclear legal status increases the possibility of eviction or demolition of the settlement (including the infrastructure). Yet, in many of these cities, electricity or telephone services are being provided in informal settlements where water connections are said to be illegal and impossible.

More critical however is the concern amongst authorities that if pipes are installed in areas without legal status, their permanence may be seen as providing a stamp of approval or some degree of legitimacy to the residents. Evidence also suggests that, in practice, the main barrier to the extension of public services in informal settlements is not the irregularity, but the lack of political will. In many cases, the failure to extend services is a result of rigid or outdated policy and legislation, as well as a lack of official recognition of the magnitude and scale of the

problem. In some countries such as Ethiopia, Tanzania and Nigeria, security of tenure is not a major constraint, and there are limited administrative or legal restrictions that prevent the utility from extending the network to most communities. In other situations, such as in Kenya and Côte d'Ivoire, the lack of secure tenure is a significant blockage, one of many administrative and legal barriers constraining improvements in the access of low-income households. Authorities should make efforts to address security of tenure constraints by direct and indirect action. This may include:

i. Facilitating some form of immediate tenure that may stop short of full land title. (A full form of title may be laborious to arrange and a less contentious form may still give residents and utilities the comfort that occupation is guaranteed for a fixed period of time (e.g. the right to occupy the land for 10 years).

ii. Agreeing in principle that all consumers should be provided with access to water supply regardless of their location and that the service provider be given the mandate to work with any community to design and deliver an appropriate service.

iii. Allowing the service provider to modify their traditional approaches and procedures to make service provision feasible in the short and medium term (e.g. by permitting pipes to be laid for an agreed period, laying pipes above ground.

Laying piped water supply networks also requires a certain amount of planning (or order) in the layout of the settlement. While this ensures that construction and operation is feasible and efficient, the absence of a planned layout should not pass as an argument against network extension – just as the lack of land tenure should not constrain provision in informal settlements. It is of course inevitable that underground piped systems are more difficult to install where the layout is somewhat haphazard and it is therefore necessary to consider alternative options that

suit the local conditions. Some of these will be similar to those solutions proposed to overcome the constraints of informality, such as laying pipes above ground and/or through private land (Collignon,1999). Municipalities have attempted to address the unplanned nature of low-income settlements in a range of ways. In conjunction with residents and resident's associations, some municipalities have established intermediate planning measures as part of an overall urban development project. These measures have enabled municipalities (e.g. Man, a town in Côte d'Ivoire) to agree the layout for water supply lines, drainage and other urban infrastructure and to set aside uninterrupted public space for this purpose (as in a service corridor).

Other municipalities have formed agreements with the main service provider that will allow independent and intermediate providers to establish temporary facilities – either through a temporary permit/license or moratorium. In Ouagadougou, Burkina Faso, 25 stand-alone water points (pumping stations with boreholes supplying a tank and standpipe) were designed so that they could be moved when demand changed and in Durban, it has been agreed that services will be provided in temporary settlements and moved if and when it becomes necessary.

2.6 THE PIPE BORNE WATER SUPPLY PROGRAMME OF KADUNA METROPOLIS

Pipe borne water supply in Kaduna metropolis is the responsibility of the Kaduna State Water Board (KSWB). The KSWB currently supply water to most parts of the metropolis. Although pipe borne water supply is irregular and erratic in nature within the metropolitan core as a result of low water storage capacity of earth dam and low water treatment plant capacity. The water treatment plants which currently serves the metropolis has a combined capacity of 146 Million Litres/Day (Mld), expected to meet the water needs of 1,361, 614 population of the metropolis.

The capacity of treatment plants has a shortfall of 22,393, 680 Mld. The KSWB acknowledged inability to supply adequate pipe borne water to the core metropolis. This then explains the pipe borne water supply situation in peripheral settlements (The KSWB, 2012).

Households with access to pipe borne water connect to mains directly with the approval of KSWB and in some cases, water meters are installed to enable proper billing of customers. The use of water meter is effective in the older parts of the metropolis and lacking in most areas. The average bill payable by households is ₦1,379 (The KSWB, 2012).

The reasons given for the inability of KSWB to supply water to all parts of the metropolis has to do with situation of present dam which is the source of water to treatment plants. The challenge of poor funding is responsible for the inability of KSWB to ensure connection and distribution of pipe water to every part of the metropolis. This situation is worsened by the poor cost recovery mechanism of the KSWB, as most areas do not receive water bill regularly.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 INTRODUCTION

The methodology for this research was developed based on the need to understanding the characteristics and challenges of water supply in peripheral settlements of Kaduna metropolis. The methodology identified types and sources of data required; methods of data collection; data analysis and presentation; sample frame and size.

3.1 DATA REQUIRED AND SOURCES

The required data for this study complied with the set objectives. Data were obtained through questionnaire administration, oral interviews, and observations to gain insight into water supply characteristics and challenges in Peripheral settlements of Kaduna Metropolis. Review of relevant literature on water supply to peripheral settlements; relationship between planning and water supply were undertaken using published and unpublished literatures such as textbooks, journals, research reports and various internet sources.

Table 3.1: Data Type, description and sources

	DATA TYPE	DATA DESCRIPTION	SOURCES
Primary Data	**Household characteristics**		
	Household Background Data	Household profile relevant to water demand and supply analysis such as Family size and monthly income,	Responses from Residents of peripheral settlements of Kaduna metropolis through the use of questionnaire
	Water Demand characteristics		
	Access	Information on adequacy of water from different sources of supply. Estimated litres of water consumed on daily basis.	Responses from Residents of peripheral settlements of Kaduna metropolis through the use of questionnaire
		Areas with and without connection to metropolitan pipe borne water supply network and the nature of connection.	Responses from Residents of peripheral settlements of Kaduna metropolis through the use of questionnaire and observation
		Type of access to water whether direct connection to individual households, yard taps or public tap points	Responses from Residents of peripheral settlements of Kaduna metropolis through the use of questionnaire
		Reasons behind non connection of peripheral settlements to public water supply system and distribution. Also to establish the relationship between authorities responsible for city growth and water supply	The Kaduna State Water Board (KSWB) and Kaduna State Urban Planning and Development Authority (KASUPDA)
	Water supply characteristics		
	Water Quantity	Data on quantity of water supplied and how it meets residents water demand	The KSWB Report
	Source(s) of water supply	Capacity of water treatment plant supplying water to Kaduna metropolis and to establish whether supply can be made from the same source to all peripheral settlements	Interview with the officials of the KSWB
	Alternative sources of water supply	The establishment of other sources of water supply in peripheral settlements	Responses from Residents of peripheral settlements of Kaduna metropolis

			through the use of questionnaire
	Data on Impact Areas		
	Planning status of peripheral settlements	Data on peripheral settlements identified, to establish their planning status and to establish their impact on water supply.	Interview with KASUPDA General Manager/Director of Planning and other senior personnel of the authority.
	Reasons for current level of water supply to peripheral settlements	Details on why some peripheral settlements are not serviced with pipe borne water supply and distribution.	Interview with the officials of the KSWB
	Prospects for sustainable supply		
	Willingness to pay for water	Data to establish households willingness to pay for water supply as means of cost recovery	Responses from Residents of peripheral settlements of Kaduna metropolis through the use of questionnaire
	Present expenses on water	Information on cost incurred to secure water daily.	Responses from Residents of peripheral settlements of Kaduna metropolis through the use of questionnaire
Secondary Data	Literature review	Concepts of peripheral settlements, water supply, relationship between planning and water supply, models and frameworks for water supply and planning process for water supply.	Published and unpublished literatures on urban water supply from Libraries and the use of internet.
	Map of Kaduna metropolis showing peripheral settlements	Details of houses in peripheral settlements through the count of roof as captured by imageries	The use of Google earth to capture each peripheral settlement in order to provide idea on number of houses used as sample frame.

Source: Field, 2011

3.2 SAMPLE FRAME

The sample frame for this study consists of housing units in peripheral settlements of Kaduna Metropolis where, household projections were made using Google earth imagery count of roofs

in peripheral settlements. A total number of 41,072 roofs were identified and the assumption of two households in each identified roof was made giving a total of 82,144 households as shown in the table below. The assumption of two households per roof was found to be valid through confirmation by the Bureau of Statistics data from the 2006 National population census data. The use of this method is justified due to lack of readily available data on peripheral settlements as a result of their changing nature.

Table 3.2: Peripheral Settlements and detail information

S/No	Peripheral Settlement	Number of Houses	Number of Households	Status of Settlement	Local government
1	Romi	8,979	17,958	Unplanned	Chikun
2	Gonin Gora	8,431	16,862	Unplanned	Chikun
3	Kudenda	1,482	2,964	Unplanned	Chikun
4	Ungwa Maigero	847	1,694	Unplanned	Chikun
5	Mahuta	426	852	Unplanned	Chikun
6	Kamanzo	821	1,642	Unplanned	Chikun
7	Tsaunin Kura	478	956	Planned	Chikun
8	Mararaban Rido	2,873	5,746	Unplanned	Chikun
9	Mando	5,641	11,282	Unplanned	Igabi
10	Rigasa	7,641	15,282	Unplanned	Igabi
11	Trade fair layout	723	1,446	Planned	Igabi
12	Rafin Guza	207	414	Planned	Igabi
13	Rigachukun	2,501	5002	Unplanned	Igabi

Source: Satellite Imagery and Bureau of Statistics

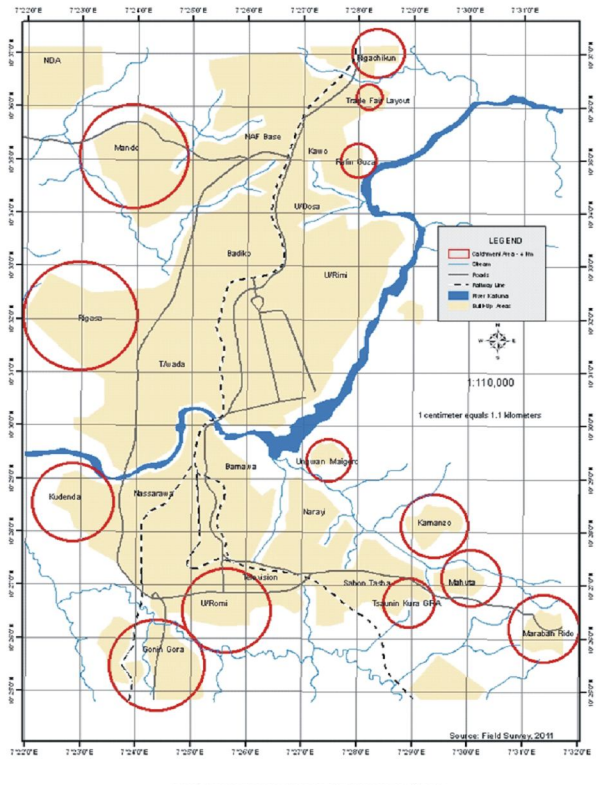


Fig. 3.1: Physical Location of peripheral Settlements of Kaduna Metropolis

3.3 SAMPLE SIZE

The sample size was taken at two levels: first 70% of 13 peripheral settlements were sampled, giving 9 settlements cutting across the two local governments where peripheral settlements are located. The second sample size is the projected households from the sampled settlements, which is 0.5% of 61,182 giving a total number of 305 samples. The selected settlements were grouped into household range and settlements were chosen based on fair representation of identified peripheral settlements by local governments. Details are shown in the table below:

Table 3.3: Grouping of Peripheral Settlements of Kaduna Metropolis

Household Range	Settlement Group	Selected settlements	No. of Households	No. of samples
1 – 7,000	Small	Kudenda,	2,964	14
		Kamanzo,	1,642	8
		Tsaunin Kura	956	6
		Trade fair Layout	1,446	7
7,001 – 13,000	Medium	Mararaban Rido	5,746	29
		Rigachukun	5002	25
		Mando	11,282	56
13,001 – 20,000	Large	Gonin Gora	16,862	84
		Rigasa	15,282	76
			61,182	**305**

Source: Author, 2011

3.4 SAMPLING METHODS

Stratified random sampling method was adopted for this research where peripheral settlements of the metropolis were divided into three: Small, Medium and Large peripheral settlements. A total of 35 questionnaires were administered to small peripheral settlements, 54 to Medium, and 216 to Large peripheral settlements respectively, as shown in table 3. Systematic random sampling technique was adopted in questionnaire administration where the first household was chosen at random and the next were administered to household head at interval of ten houses.

3.5 METHODS OF DATA COLLECTION

Secondary data needed for this study were sourced through review of existing literature on concepts of water supply and distribution to new areas of the city, planning process and consideration for water supply to peripheral settlements.

3.5.1 Questionnaires Administration

Survey method using structured questionnaires where formal list of questions asked of all respondents in the same way. The questions in the questionnaire were made of both close and open ended type to provide easy answers and explanation were necessary. The questionnaire was divided into sections to capture the aspects that satisfy research data.

A total number of three hundred and five questionnaires were administered. First questionnaires were administered to respondents to complete and return but some were discovered missing. So the employment of field assistants for data collection became necessary. At the end of data collection, two hundred and sixty nine questionnaires were recovered duly completed by respondents.

3.5.2 Oral Interview

Intercept interviews were conducted to collect primary data on challenges of water supply by public and private water suppliers to peripheral settlements in order to find challenges faced. The choice of intercept interview was because it allows the researcher to reach known respondents in a short period of time. It also involves talking to people at homes, offices or even on the street. These interviews provided useful information on challenges faced by water suppliers with regards to peripheral settlements of the metropolis.

3.6 DATA COLLATION, ANALYSIS AND PRESENTATION

Data collation was undertaken using coding sheet to organize responses directly from questionnaires for easy input into SPSS software for further analysis. Data analysis was carried out using descriptive statistical tools such as tables to depict the nature and pattern of water supply, percentage to provide overview picture of the nature of water supply and cross tabulation

to establish the influence of one variable on another. Maps were use to present patterns from one settlement to the other. This is crucial to understanding the nature and pattern of water supply in these settlements.

CHAPTER FOUR

CHARACTERISTICS AND PROBLEMS OF WATER SUPPLY IN PERIPHERAL SETTLEMENTS

4.0 WATER SUPPLY CHARACTERISTICS AND PATTERN

This section provides information on sources and nature of water supply and pattern from different sources. Detailed discussion on pipe borne, boreholes, wells, river and vendor supplied water were discussed. Based on the analysis, water supply problems were identified.

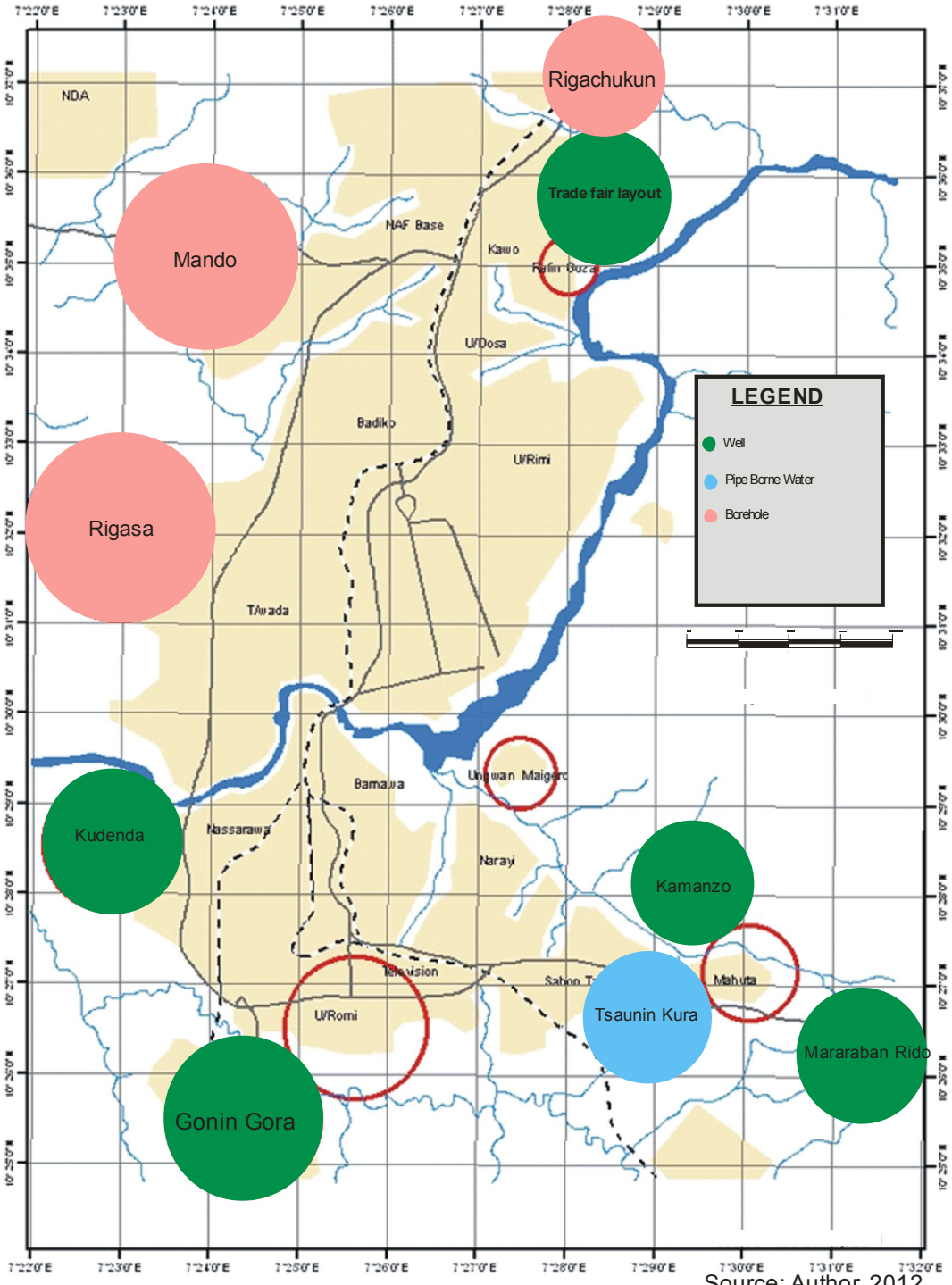
4.1 SOURCES OF WATER SUPPLY IN PERIPHERAL SETTLEMENTS

Data from the field survey revealed that peripheral settlements of Kaduna metropolis receive water from a number of sources that include borehole, dug well, pipe borne water, river and stream. The predominant supply source is Borehole accounting for 50.2% of water access. Dug well supplies is next in importance at 40.1% and Pipe borne water is accessible to 8.9% of the population. Inferred from the statistics over 90% of the settlements depend on sources other than pipe borne supplies, which corresponds with the situation in most third world cities as shown in table 4.1 and fig. 4.1 respectively. To determine how supplies are managed by source. A further analysis was carried out and the results are discussed in the following sections.

Table 4.1: Source of Water supply

Source	Frequency	Percent
Pipe borne	24	8.9
Dug Well	108	40.1
Borehole	135	50.2
River/Streams	2	0.7
Total	**269**	**100.0**

Source: Field survey, 2012



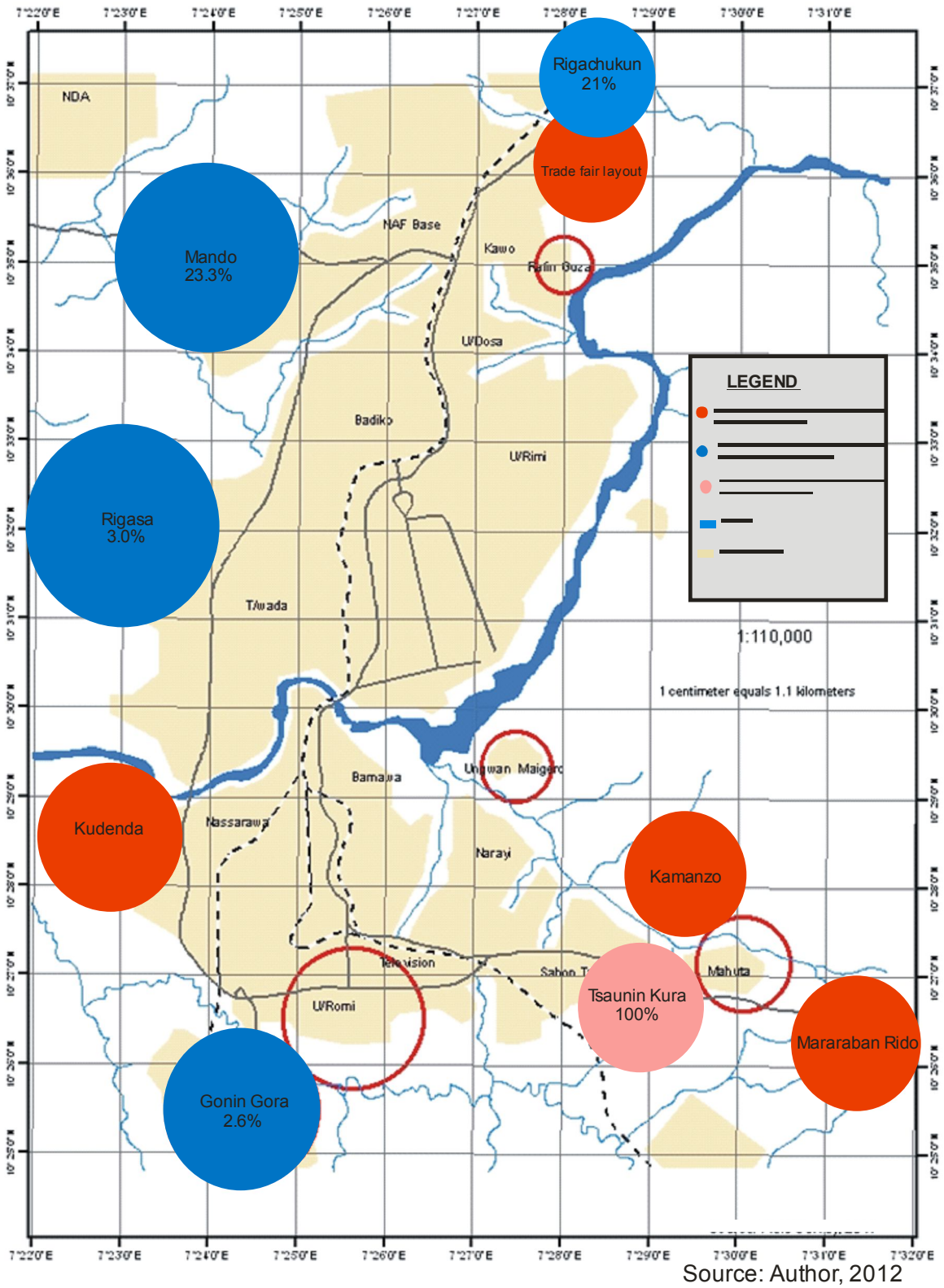
Source: Author, 2012

Fig. 4.1: Settlements Sources of water supply

4.1.1 Pipe borne water supply

Pipe borne water considered to be safe, cheap and convenient serves only a small proportion of the population. Of the 9 settlements only Tsaunin Kura has appreciable supplies of pipe borne water. The percentage of total population with access is 8.9%. In Gonin Gora supplies reach only 2.6% of the population, Rigachukun 2.1%, Rigasa 3% and Mando 3.3%. Mararaban Rido, Trade fair layout and Kamanzo have no provision for pipe borne water supply at all (see fig.4.3). The limited reach of households to meet basic needs explains the increasing dependence on other available, but unreliable and inconvenient sources.

The study went further to classify settlements having basic network infrastructure and into those receiving supplies and of the 9 settlements, about 66% have basic networks and receive supplies. In this category only Tsaunin Kura has regular daily supplies, while others receive once a week, or once a month. Kudenda stands out as the only settlement with connection but without supplies, as supply was last received on the day of project commissioning in 2005.



Source: Author, 2012

Fig. 4.1: Pattern of pipe borne water supply in peripheral settlements of Kaduna Metropolis

The next issue explored is the water supply regimes for settlements that have network. Data obtained is shown in table 4.2. The highest water supply duration is about 3 hours a day in Tsaunin Kura. About 4.5% receive supplies over 3 hours every 3 days, and 0.7% receive less than 3 hours in a whole week, and 1.5% receive supplies once in a month and for an average of 3 hours.

Table 4.2: Pipe borne water duration

Duration	Frequency	Percent
Some hours in a week	6	2.2
Few hours in 3 days	12	4.5
Few hours in a week	2	.7
Few hours in one month	4	1.5
Not Applicable	245	91.1
Total	**269**	**100.0**

Source: Field survey, 2012

Across all the settlements with provision for pipe borne water supplies are received only during the morning hours. As supplies are generally inadequate and grossly unreliable, households are compelled to rely on other sources which are not only unsafe but expensive.

4.1.2 Borehole water supply

Boreholes are the most predominant source of water in the absence of pipe borne water supplies. As established, about 50.2% of the population are dependent on boreholes as shown in table 4.1. The statistics at the individual settlement level is shown in table 4.3. It suggests that households in Trade fair layout and Rigasa are the most dependent on boreholes and Mararaban Rido, the least. Tsaunin Kura and Kudenda have households with the least reliance on boreholes. The situation in Tsaunin Kura is influenced by the availability of pipe borne supplies. The dominance

of well usage at Kudenda is explained by the high water table as the settlement is close to River Kaduna.

Table 4.3: Sources of Water supply in each peripheral settlement

Gonin Gora	**Frequency**	**Percent**
Pipe borne	2	2.6
Dug Well	41	52.6
Borehole	35	44.9
Total	78	100.0
Mararaban Rido		Percent
Dug Well	24	88.9
Borehole	3	11.1
Total	27	100.0
Rigachukun		Percent
Pipe borne	4	21.1
Dug Well	2	10.5
Borehole	13	68.4
Total	19	100.0
Rigasa		Percent
Pipe borne	2	3.0
Dug Well	10	14.9
Borehole	54	80.6
River/Streams	1	1.5
Total	67	100.0
Trade fair Layout		Percent
Borehole	7	100.0
Tsaunin Kura		Percent
Pipe borne	6	100.0
Mando		Percent
Pipe borne	10	23.3
Dug Well	8	18.6
Borehole	24	55.8
River/Streams	1	2.3
Total	43	100.0
Kudenda		Percent
Dug Well	14	100.0
Kamanzo		Percent
Dug Well	6	75.0
Borehole	2	25.0
Total	8	100.0

Source: Field survey, 2012

Borehole ownership was established from the survey and data is shown in table 4.4. The ownership is mostly by individuals as commercial business, which accounts for 62.1% and a major source where water vendors buy water and sell to households. About 20% of boreholes are provided by individuals for private use only and Only about 7.5% of boreholes are sunk by government. Community sunk boreholes constitute 7.5% of the total number of boreholes.

Table 4.4: Borehole Ownership

Type of ownership	Frequency	Percent
Government	15	10.3
Individual on commercial basis	90	62.1
Community	11	7.5
Private individual	29	20.0
Total	**145**	**100.0**

Source: Field Survey, 2012

Rigasa has the highest concentration of commercial boreholes. Trade fair layout and Rigachukun have the highest concentration of private and government sunk boreholes respectively. Detail of borehole ownership in each peripheral settlements is shown in table 4.5 below.

Table 4.5: Borehole ownership in each settlement

Gonin Gora	**Frequency**	**Percent**
Government	2	2.6
Individual on commercial basis	22	28.2
Community	5	6.4
Private individual	9	11.5
Not applicable	40	51.3
Total	78	100.0
Mararaban Rido	**Frequency**	**Percent**
Private individual	3	11.1
Not applicable	24	88.9
Total	27	100.0
Rigachukun	**Frequency**	**Percent**
Government	8	42.1
Individual on commercial basis	5	26.3
Not applicable	6	31.6
Total	19	100.0
Rigasa	Frequency	Percent

Government	1	1.5
Individual on commercial basis	47	70.1
Community	2	3.0
Private individual	4	6.0
Not applicable	13	19.4
Total	67	100.0
Trade Fair Layout	**Frequency**	**Percent**
Individual on commercial basis	4	57.1
Private individual	1	14.3
Not applicable	2	28.6
Total	7	100.0
Tsaunin Kura	Frequency	Percent
Not applicable	6	100.0
Mando	**Frequency**	**Percent**
Government	4	9.3
Individual on commercial basis	12	27.9
Community	4	9.3
Private individual	6	14.0
Not applicable	17	39.5
Total	43	100.0
Kudenda	**Frequency**	**Percent**
Not applicable	14	100.0
Total	14	100.0
Kamanzo	**Frequency**	**Percent**
Private individual	2	25.0
Not applicable	6	75.0
Total	8	100.0

Source: Field Survey, 2012

Although considered relatively safe, boreholes generally are expensive beyond the affordability of most households. thereby limiting water supply through this means. The introduction of commercially sunk boreholes increases access to water but is expensive especially when supplies are accessed through water vendors. This has the implication of cutting down family water consumption in order to minimize expenditure on water. Borehole water supply is also faced with the problem of low water table in most of the settlements. This accounts for the drying up of wells and boreholes in the dry season months of February to April (Kaduna Geological Survey, 2007). The sinking of deep boreholes has the potential of increasing cost further beyond what

households can afford. The absence of government sunk boreholes in adequate numbers has worsened the problem.

4.1.3 Water supply through Dug Wells

Water supply from wells is the second most popular source of water in the absence of pipe borne supplies. This represents supplies to about 40.1% of households as shown in table 4.1. Well supplies is the main source to Gonin Gora, Mararaban Rido, Kudenda and Kamanzo (table 4.5). Except in a few cases, wells are predominantly sunk within individual properties, in many cases not far from soak away or pit toilets in defiance of the recommended set back of 60m. This allows for seepage of contaminants into the wells. Adding to the problem of water contamination, most wells dry up between late December to early May due to low water table in the peripheral settlements.

4.1.4 Rivers and Streams

River and streams although considered bad sources of water for domestic consumption are still relied upon by some household (table 4.1). This is a bad source of water supply in urban areas where many sources of contamination are found.

4.1.5 Vendors as Suppliers of Water

Purchase of water from vendors is an indicator of poor access to water and suggests the desperate attempt of households to meet daily water supplies. Most households buy water from vendors as shown in table 4.6.

Table 4.6: Water Vendor patronage

Patronage	Frequency	Percent
Yes	171	63.6
No	98	36.4
Total	269	100.0

Source: Field survey, 2012

The danger of water supply through vendors is that the true source of water is unknown and residents risks consuming water that may not be safe due to sharp practices of water vendors, which has great health consequences.

The degree of vendor patronage was established from the study to vary across settlements. Households in Mararaban Rido and Kamanzo rely least on vendors due to high well ownership and availability of privately owned boreholes. Tsaunin Kura with low patronage on vendors results from availability of pipe borne water. The pattern of vendor patronage in each peripheral settlement is shown in fig. 4.3.

The next level of analysis reveals the pattern of vendor patronage by households having access to different sources of water supply.

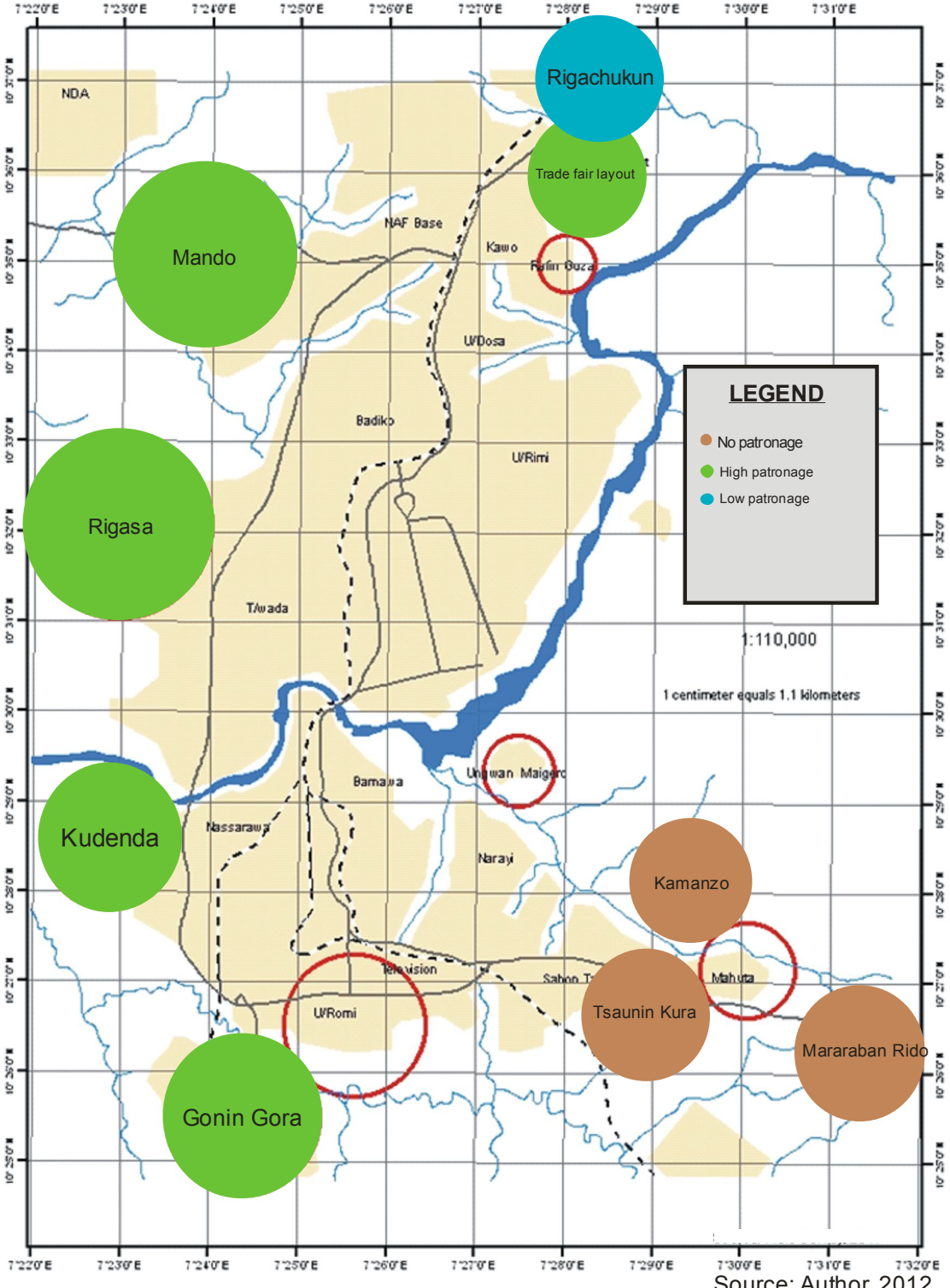
Table 4.7: Cross tabulation statistics to find relationship between respondents source of water supply and purchase of water from vendors

Source of Water Supply	**Purchase of water from vendors**		**Total**
	Yes	**No**	
Pipe borne (% within total)	13 4.8%	11 4.1%	24 8.9%
Dug well (% within total)	47 17.5%	61 22.7%	108 40.1%
Borehole (% within total)	109 40.5%	26 9.7%	135 50.22%

River/Stream (% within total)	2 0.7%	0 0%	2 0.7%
Grand total **Grand % total**	171 63.6%	98 36.4%	269 100%

Source: Field Survey,2012

The cross tabulation statistics in this regard showed that all those whose source of water is stream completely buy water from water vendors. About 54.2% of those whose source of water supply is pipe borne buy water from vendors. Those who rely on boreholes have the highest of 80.7% patronage of water vendors. This is because there is poor borehole ownership and dependence is made on borehole water by people who do not own them. Those whose source is dug well have low vendor patronage of 43.5%. Purchase of water from vendors by well owners is common during the dry season. Generally, patronage of water from vendors is high irrespective of source of water supply. This therefore, indicates high water demand that is not met by current sources.



Source: Author, 2012

Fig. 4.4: Pattern of water vendor patronage in peripheral settlements

4.1.6 Time Spent to Fetch Water

The second criterion used in evaluating the nature of water supply in the peripheral areas is the time spent to access supplies. The average time spent in accessing water supplies estimated across all settlements is about 36 minutes. Among the sources, the worst case accounted for by boreholes at above 30 minutes and the least with streams.

Table 4.8: Cross tabulation statistics between respondents source of water supply and Time spent on queue to fetch water

Source of water supply	**Time spent on queue to fetch water**					**Total**
	<10mins	**11-20 mins**	**21-30 mins**	**>30 mins**	**Not applicable**	
Pipe borne	5	1	3	4	11	24
(% within total)	1.9%	0.4%	1.1%	1.5%	4.1%	8.9%
Dug well	9	21	12	17	49	108
(% within total)	3.3%	7.8%	4.5%	6.3	18.2%	40.1%
Borehole	7	29	22	47	30	135
(% within total)	2.6%	10.8%	8.2%	17.5%	11.2%	50.2%
Rivers/Stream	0	0	2	0	0	2
(% within total)	0%	0%	0%	0%	0%	0.7%
Grand total	**21**	**51**	**39**	**68**	**90**	**269**
Grand % total	**7.8%**	**19.0%**	**14.5%**	**25.3%**	**33.5%**	**100%**

Source: Field Survey, 2012

The cross tabulation statistics in this regard showed that those whose sources of water is stream spend less time (21-30 minutes) on queue to fetch water. Compared to those whose source of water is boreholes and dug wells where average time spent is 36 minutes. The cross tabulation data generally indicates lost of valuable time to water fetching across residents with access to different sources of water

4.2 DEMAND CHARACTERISTICS AND PATTERN

Water demand and consumption pattern are crucial items that suggest the quality of life of households. The primary parameters examined are the quantity of water consumed, expenditure on supplies and time spent in accessing supplies, and distance covered to reach supplies.

4.2.1 Pattern of Demand by Households

The total population of Kaduna peripheral settlements is 657,152 people made up of 82,144 household (NPC, 2006). The projected water demand by this population established using the UN requirement of 120 litres/person/day is 78,858,240 mld.

4.2.2 Household Daily Expenditure on Water

The amount spent daily by households to access water gives indications of the quality of life of the population. It is also an indicator of the difficulties households go through to access water. The study established that majority of individual settlements level household spend a daily average of N390 on water, giving the monthly sum of N11,700 and the average water consumption of 260 litres/day. The amount spent on water is high considering the monthly expenditure on water.

Table 4.9: Quantity of water and money spent by households per day

	Quantity of water		**Amount spent**	
Quantity of water consumed	Frequency	Percent	Average expenditure	Percentage
60 litres	21	7.8	90	4.8
160 litres	68	25.3	240	12.9
260 litres	63	23.4	390	20.9
360 litres	51	19.0	540	29
400 litres	66	24.5	600	32.2
Total	**269**	**100.0**	**1860**	**100**

Source: Field Survey, 2012

The next level of analysis is the detail households quantity of water consumed and expenditure at various settlements level. Expenditure on water is ranged between the lowest of ₦90 and N600 for households that consumes between 60 and 400 litres daily respectively. Therefore, the daily and monthly expenditures ranges between N2700 to N18,000.(table 4.8). High cost is attributed to difficulty associated with accessing water regularly from distance. It also a function of the season.

Table 4.10: Price of 20 litres of water in each settlement

Gonin Gora	Frequency	Percent
<N20	6	7.7
N20 - N40	43	55.1
Not applicable	29	37.2
Total	78	100.0
Mararaban Rido	Frequency	Percent
Not applicable	27	100.0
Rigachukun	Frequency	Percent
<N20	1	5.3
N20 - N40	3	15.8
>N 40	1	5.3
Not applicable	14	73.7
Total	19	100.0
Rigasa	Frequency	Percent
<N20	9	13.4
N20 - N40	53	79.1
Not applicable	5	7.5
Total	67	100.0
Trade fair layout	Frequency	Percent
<N20	2	28.6
N20 - N40	3	42.9
Not applicable	2	28.6
Total	7	100.0
Tsaunin Kura	Frequency	Percent
Not applicable	6	100.0
Mando	Frequency	Percent
<N20	6	14.0
N20 - N40	28	65.1
>N 40	3	7.0
Not applicable	6	14.0
Total	43	100.0
Kudenda	Frequency	Percent
N20 - N40	12	85.7

Not applicable	2	14.3
Total	14	100.0
Kamanzo	Frequency	Percent
No applicable	8	100
Total	8	100.0

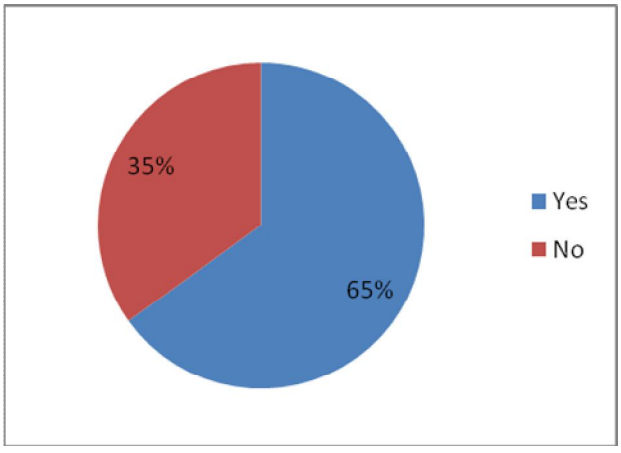
Source: Field survey, 2012

The study went further to examine the average amount spent by households in each settlement. The general pattern of expenditure on water is highest in Rigachukun, Rigasa, Mando and Kudenda with the average daily expenditure of N390. The least cases are Tsaunin Kura, Mararaban Rido and Kamanzo where households do not spend money on water at all. The non-expenditure on water in these settlements is explained by the availability of pipe borne water in Tsaunin Kura, high well and private boreholes in the other two. Other settlements spend the average of N325 daily on water

4.2.3 Presence of Queues to Fetch Water

The difficulty in meeting daily water demand was explored using data on household queue when fetching water as shown in Fig. 4.4. It revealed 65.1% of households who queue when fetching water from any source.

Fig. 4.4: Queue to Fetch Water



The variation in queues from one settlement to the other is shown in table 4.11. Only Trade fair Layout residents that do not queue to fetch water. This is attributed to access to borehole water. The time spent queuing up for water was next examined. The result obtained showed that about 38.6% of households queue up for 30 minutes and above which is bad indicator of water access where economic time is lost to water fetching. The least queuing time of less than 10 minutes is experienced by about 11.4% of households.

Table 4.11: Time Spent in queue

Time	Frequency	Percent
< 10 mins	20	11.4
11 - 20 mins	49	27.8
21 – 30	38	22.2
> 30 mins	67	38.6
Total	**176**	**100.0**

Source: Field Survey, 2012

The study went further to establish queue time in each settlement with the highest queuing time in Kamanzo to be 30 minutes and above with 83.3%. This is because households in this settlements do not have access to pipe borne water and depend on dug wells and limited number of boreholes. Tsaunin Kura has the least queuing time of less than 10 minutes with 100% as shown in table 4.10.

Table 4.12: Time spent on queue to fetch water in each settlement

Gonin Gora	Frequency	Percent
< 10 mins	7	14
11 - 20 mins	12	24
21 – 30	11	22
> 30 mins	20	40
Total	50	100.0
Mararaban Rido	Frequency	Percent
11 - 20 mins	3	33.3
21 – 30	2	22.2
> 30 mins	4	44.5
Total	9	100

Rigachukun	Frequency	Percent
< 10 mins	2	18.2
11 - 20 mins	3	27.2
21 – 30	1	9.1
> 30 mins	5	45.5
Total	11	100.0
Trade fair layout	Frequency	Percent
< 10 mins	4	6.6
11 - 20 mins	20	33.4
21 – 30	12	20
> 30 mins	24	40
Total	60	100.0
Tsaunin Kura	Frequency	Percent
< 10 mins	1	100.0
Total	1	100.0
Mando	Frequency	Percent
< 10 mins	4	12.6
11 - 20 mins	8	25
21 – 30	10	31.2
> 30 mins	10	31.2
Total	32	100.0
Kudenda	Frequency	Percent
< 10 mins	3	30
11 - 20 mins	4	40
21 – 30	3	30
Total	10	100.0
Kamanzo	Frequency	Percent
11 - 20 mins	1	16.7
> 30 mins	5	83.3
Total	6	100.0

Source: Field survey, 2012

4.3 PROBLEMS OF WATER SUPPLY IN THE PERIPHERAL SETTLEMENTS

4.3.1 Inadequate Supplies

The general situation as revealed through analysis is that peripheral settlements of Kaduna metropolis face various levels of difficulties in accessing water. Pipe borne water is generally low and irregular in nature. Borehole supplies are inadequate as public boreholes in most cases have failed because they are poorly sunk and maintained. Dug wells and some boreholes dry up

in the dry season due to low water table of the metropolis. This is revealed using data on quantity of water used daily by households and household size as shown in tables 4.12.

Table 4.13: Quantity of water used per household per day

Number of jars	Frequency	Percent
1 - 5 of 20 litres jar	21	7.8
6 - 10 of 20 litres jar	68	25.3
11 - 15 of 20 litres jar	63	23.4
16 - 20 of 20 litres jar	51	19.0
>20 of 20 litres jar	66	24.5
Total	269	100.0

Source: Field Survey, 2012

The capacity of water treatment plants serving the metropolis presently is shown in the three plants of Old and New Malali and Kaduna South with a combined capacity of 146,000,000. The largest of the three is new Malali with a capacity of 70 mld.

Table 4.14: Water Treatment Plants in Kaduna Metropolis

S/No.	Name of Treatment Plant	Capacity (Mld)
1	Old Malali	40
2	New Malali	70
3	Kaduna South	36
	Total	146

**Mld = Million Litres per Day*
Source: KSWB, 2012

These capacities of treatment plant which currently supply pipe borne water to the metropolis is 146 mld of water and the projected population of 2012 is 1,361,614 people giving a total water demand of 163,393,680Mld. This reveal that the capacity of water treatment plants currently supplying water to the metropolitan core has a shortfall supply of 22,393,680Mld. This then explained the pipe borne water supply characteristics and pattern in peripheral settlements of Kaduna since water from the three city treatment plants cannot serve the need of the metropolitan core, let alone the periphery.

Table 4.14 shows the categories of family sizes in peripheral settlements of Kaduna metropolis. The highest family size is between 5 – 8 and the least is 12 and above. The average family size is 8 person per household.

Table 4.15: Family Size

Size	Frequency	Percent
1 – 4	79	29.4
5 – 8	109	40.5
9 – 12	54	20.1
12 and above	27	10.0
Total	269	100.0

Source: Field survey, 2012

A look at the average household size of 8 persons and average water consumption of 260 litres per household leaves an excess water demand of 700 litres using the United Nation(U.N.) per capita per day water demand of 120 litres/person/day. It therefore imply that households of peripheral settlements of Kaduna are limited to consuming less water on daily basis than the U.N. minimum consumption rate. This has implication on sanitary conditions and health of residents.

Inadequacy in supply is further explained using cross tabulation statistics as shown in the table 4.15. Household size is a determinant of water demand. Knowledge of quantity of water consumed daily by a household reveals shortfall or adequacy of water supply.

Table 4.16: Cross tabulation statistics between respondents Family size and Quantity of water used daily by a family

Family size	**Quantity of water used daily by a family**					**Total**
	1-5 of 20 litres jar	**6-10 of 20 litres jar**	**11-15 of 20 litres jar**	**16-20 of 20 litres jar**	**>20 of 20 litres jar**	
1 – 4	15	31	13	9	11	79
(% within total)	5.6%	11.5%	4.8%	3.3%	4.1%	29.4%

5 – 8 (% within total)	4 1.5%	20 7.4%	34 12.6%	29 10.8%	22 8.2%	109 40.2%
9 – 12 (% within total)	2 0.7%	12 4.5%	12 4.5%	11 4.1%	17 6.3%	54 20.1%
12 and above	0 0%	5 1.9%	4 1.5%	2 0.7%	16 5.9%	27 10.0%
Grand total **Grand % total**	21 7.8%	68 25.3%	63 23.4%	51 19.0%	66 24.5%	269 100%

Source: Field Survey 2012

The cross tabulation statistics in this regard showed that while large family size of 12 and above consumes over 400 litres jars of water daily, low family size of 1- 4 consumes 120 – 200 litres and 20 to 100 litres of water a day. It therefore implies that large households consumes more water and generate high water demand than small households. The explanation for this is that, individual water needs sums up household water demand. Inadequacy of pipe borne water supply is explained by the short capacity of water treatment plants which currently supplies water to the metropolitan core and the poor budgetary allocation to the KSWB. The supply from other sources is threaten during the dry season due to low water table in most peripheral settlements leading to drying up of wells and boreholes. The general inadequacy in water supply has varying health and socio-economic consequences on residents.

4.3.2 High Expenditure on water

In the absence of pipe borne water, commercial boreholes are the predominant sources of water in peripheral settlements. This has high cost implication on households income where a large chunk is spent on water with an average monthly expenditure of ₦11,700. This amount is

outreageous when compared to the average monthly water bill of ₦1,370 for households in the metropolitan core.

The study went further to establish a percentage of average monthly incomes of households that is spent on water. The highest household income category ranges between ₦37,000 – ₦54,000 with 40.9% and the least households whose monthly incomes are less than ₦18,000. The average household monthly income as shown in table 4.15 is ₦54,500.

Table 4.17: Family monthly income

Household incomes	Frequency	Percent
Less or equal N18,000	26	9.7
N19,000 - N36,000	51	19.0
N 37,000 - N54,000	110	40.9
N55.000 - N72,000	25	9.3
N 73,000 - N 90,000	30	11.2
Above 90,000	27	10.0
Total	269	100.0

Source: Field Survey, 2012

It therefore implies that 21.5% of household average monthly income is expended on water. This has the implication of increasing poverty among households due to high expenditure of monthly incomes on water. The high expenditure on water is explained by inadequate and unreliable supplies which creates scarcity and subsequently cost of water purchase from vendors.

The next level of analysis attempts to establsih the influence of income on quantity of water consumed daily by households as income is a determinant of water demand.

Table 4.18: Cross tabulation statistics between Family Income and Quantity of water used daily by a family

Family Income	Quantity of water used daily by a family					Total
	1-5 of 20 litres jar	6-10 of 20 litres jar	11-15 of 20 litres jar	16-20 of 20 litres jar	>20 of 20 litres jar	
Less or equal ₦18,000	5	8	5	5	3	26

(% within total)	1.9%	3.0%	1.9%	1.9%	1.1	9.7%
₦ 19,000 – ₦ 26,000 (% within total)	11 4.1%	17 6.3%	12 4.5	2 0.7%	9 3.3	51 19.0%
₦ 27,000-54,000 (% within total)	5 1.9%	34 12.6%	31 11.5%	24 8.9%	16 5.9%	110 40.9%
₦ 55,000-72,000 (% within total)	0 0%	4 1.5%	9 3.3%	1 0.4%	11 4.1%	25 9.3%
₦ 73,000- 90,000	0 0%	3 1.1%	5 1.9%	9 3.3%	13 4.8%	30 11.2%
Above ₦ 90,000 (% within total)	0 0%	2 2.9%	1 1.6%	10 19.6%	14 21.2%	27 10.0%
Grand total **Grand % total**	21 7.8%	68 25.3%	63 23.4%	51 19.0%	66 24.5%	269 100%

Source: Field survey, 2012

The cross tabulation statistics in this regard showed that the low monthly income families consumes less water than high income families. This implies that families with high incomes have the ability to meet daily water demand than those from the low income group. The high water consumption by high income families reflects the ability to purchase water, sink boreholes or extend pipe borne water supply.

4.3.3 Unreliable water supply

The problem of water supply in peripheral settlements is characterized by peaked scarcity in the dry season due to high reliance on boreholes and dug wells in the absence of pipe borne water. Pipe borne water supply is inadequate which leads to rationing with supplies only for maximum time of 3 hours a day, week or even month. Water supply through boreholes and wells are normally unpredictable as the two sources dry up in the dry season due to low water table in the settlements. The implication of unreliable sources is high expenditure as well as reliance on unsafe and expensive sources. Unreliability of sources of water supply is further explained using cross tabulation statistics below.

Table 4. 19: Cross tabulation statistics between respondents Satisfaction with Current water supply and Source of water supply

Satisfaction with current water supply	Source of water supply				Total
Yes	6	6	12	0	24
(%within total)	2.2%	2.2%	4.5%	0%	8.9%
No	18	102	123	2	245
(%within total)	6.7%	37.9%	0.7%	0.7%	91.1
Grand total	24	108	135	2	269
Grand % total	89%	40.1%	50.2%	0.7%	100%

Source: Field Survey, 2012

The residents of peripheral settlements are generally not satisfied with their sources of water supply. The cross tabulation statistics in this regard showed that while 50% are not satisfied with boreholes as their water source. About 75% of household are not satisfied with dug well or pipe borne water supply.

4.3.4 Inadequate Water Consumption

Water consumption is generally considered inadequate in peripheral settlements. The data on water consumption revealed an average household consumption of 260 litres/day and an individual water consumption of 32.5litres/person/day. This is far below the UN minimum daily requirement of 120 litre/person/day. Inadequate water supply leads to high cost of purchase from vendors, which makes families cut down on water consumption in order to increase savings for other needs. Cutting down water consumption has health implication of reduction in personal hygiene and poor management of sanitary conditions.

4.3.5 Time Wastage in Accessing Water

As established that the average time spent on queue for water fetching is over 30 minutes, shows that valuable time is wasted that can be committed to other economic activities. Time spent queuing is responsible for dropping out of pupils and women in schools to water fetching. Queues are inevitable when scarcity of water and unreliable supply exists. Water scarcity common in the dry season when water drops too low leading to drying up of wells and boreholes. Unreliable supply is a function of inadequate supply of pipe borne water and in cases very low supply regimes.

CHAPTER FIVE

DISCUSSION

5.0 PROSPECTS FOR SUSTAINABLE WATER SUPPLY

5.1 CHALLENGES

5.1.1 Poor Physical Conditions

Land for residential development in peripheral settlements is considered cheaper than in the city core. This is due to non-existence of infrastructure and poor conditions of areas in which peripheral settlements are located. These areas are less desirable for formal developments due to unplanned nature, steep slopes, along gullies and river areas, rocky soil and areas prone to flooding. The attraction to these areas being that the land are relatively cheap to purchase or because illegal occupation of such sites is less likely to be challenged.

Due to lack of technical know-how, these settlements are mostly developed haphazardly without provision for service right of way. This is so as only two out of the nine peripheral settlements studied are planned. The lack of provision for service right of way has cost implication when new water infrastructure are to be installed.

5.1.2 Poor Management of Metropolitan Growth and Development

Another unique issue is the lack of synergy between authorities concerned with managing city growth and development. The KASUPDA, Ministry of Lands, Survey and Country Planning, KSWB, Ministry of Works and PHCN do not work together to plan and implement the development of new settlements within the metropolis. This is responsible for the outcomes of

this research where Trade fair layout despite its planned status does not receive pipe borne water. While parts of Rigachukun, Mando and Rigasa receives pipe borne water supply.

The entire metropolis at the moment does not have functional strategic Land Use Plan which specifies the extent and types of physical development, that form the basis for water projection and planning. The metropolis does not have a Priority Infrastructure Plan which carries detail utility distribution lines for the entire metropolis and provisions for future expansion. These two plans are crucial to establishing water service needs and priorities, identification of key stakeholders and their requirements, determine short, medium and long term strategies (infrastructure investment and non-asset solutions) in relation to major components (sources, trunk mains, treatment plants), to assess the social, environmental and financial implications, and identify future land requirement for various activities.

5.1.3 High Water Demand and Poor Supply Pattern

An important demand indicator for water in peripheral settlements of Kaduna is the quantity of water a person consumes in a households a day. It was established that most households families consumes over 400litre of water daily. Although the quantity of water used daily by a household depends on household size and income. It was established that families with larger size consume more water than those with lower sizes. Analysis also revealed a significant relationship between household income and quantity of water consumed daily by household. Households with high income access water with ease than those with small incomes as shown in the hypotheses test below. Despite this demand it was established that per capita water consumption is 32.6litres/person/day.

5.1.4 Water Suppliers Challenges

It was identified during the course of this study that water suppliers in peripheral settlements of Kaduna metropolis are broadly grouped into public sector providers (KSWB, Ministry of Water Resources, Local Government and Ministry of Works), private commercial and non-commercial provides.

The KSWB is principal water supplier of the public sector saddled with the responsibility of supplying water to all parts of Kaduna metropolis. This organization is responsible for the supply of pipe borne water metropolitan population. It also plan pipe borne water to extension to new areas putting into consideration return on investment and available financial resources at their disposal. It was explained by the KSWB that the growth of the peripheral settlement was sporadic due to push factors in the metropolis and pull factors of the peripheral settlements. The major problem confronting the KSWB is the low capacity of water treatment plants, which is currently less than the water demand of the metropolis, let alone the peripheral settlements. The next challenge is that of the dam supplying water to treatment plants. The dam does supply required water quantity to treatment plants, especially in the dry season thereby indicating a need for an additional water dam.

The Ministry of Water Resources and local governments are responsible for boreholes in parts of the metropolis where pipe borne water supply is not regular or exists. Boreholes serves as remedy to critical shortfall in pipe borne water supply. But public boreholes are poorly sunk and maintained in all the peripheral settlements of the metropolis.

Private commercial providers contribute significantly to water supply in peripheral areas with accompanied financial gains. It was gathered through oral interview that commercial borehole

owners sell water at N5 per container and make an average of N4,000 daily. This method functions effectively in Rigasa where water demand is high due to high population concentration and reliance on boreholes for water supply. The challenge of this supply is that when borehole breakdown and requires significant amount for repairs, it takes time for an individual to undertake repairs.

5.1.5 Environmental Challenges

The site conditions in which peripheral settlements are located in most cases poses serious challenges to the provisioning of pipe borne water infrastructure. Tsaunin Kura and Trade fair layouts are the only settlements located on a relatively flat terrains. The rest of other settlements are located on sloppy terrain, flood prone and hilly areas. These site conditions has cost implication when pipe borne water supply is to be extended.

The scattered nature of peripheral settlements is another environmental challenge. The peripheral settlements are not developed along one direction. The cost of extending main and distribution pipelines to one direction is less than what is required to several directions. The location of the settlements requires heavy capital investment for installation of distribution network. This is explained by the lack of land use plan and functional Master plan for the metropolis which indicates direction of growth as basis for utility extension.

Although the need for an additional dam is established by the authority and Ministry of Water resources, to be constructed along Mararaban Rido in order to prepare for further city expansion in the southern part of the metropolis. The river source in which water is to be drained into the earth dam when constructed still remain the major challenge.

5.2 OPPORTUNITIES

This is explained through the application of data on regularity of water bill to areas with access to pipe borne water and willingness to pay water bills. If areas with access to pipe borne water get water bill regularly, it is an indication of good cost recovery mechanism which will in turn ensure sustainable water supply. In an event where bills are not regular or not issued at all, indicates poor cost recovery system.

5.2.1 Interest for Pipe Borne Water Supply

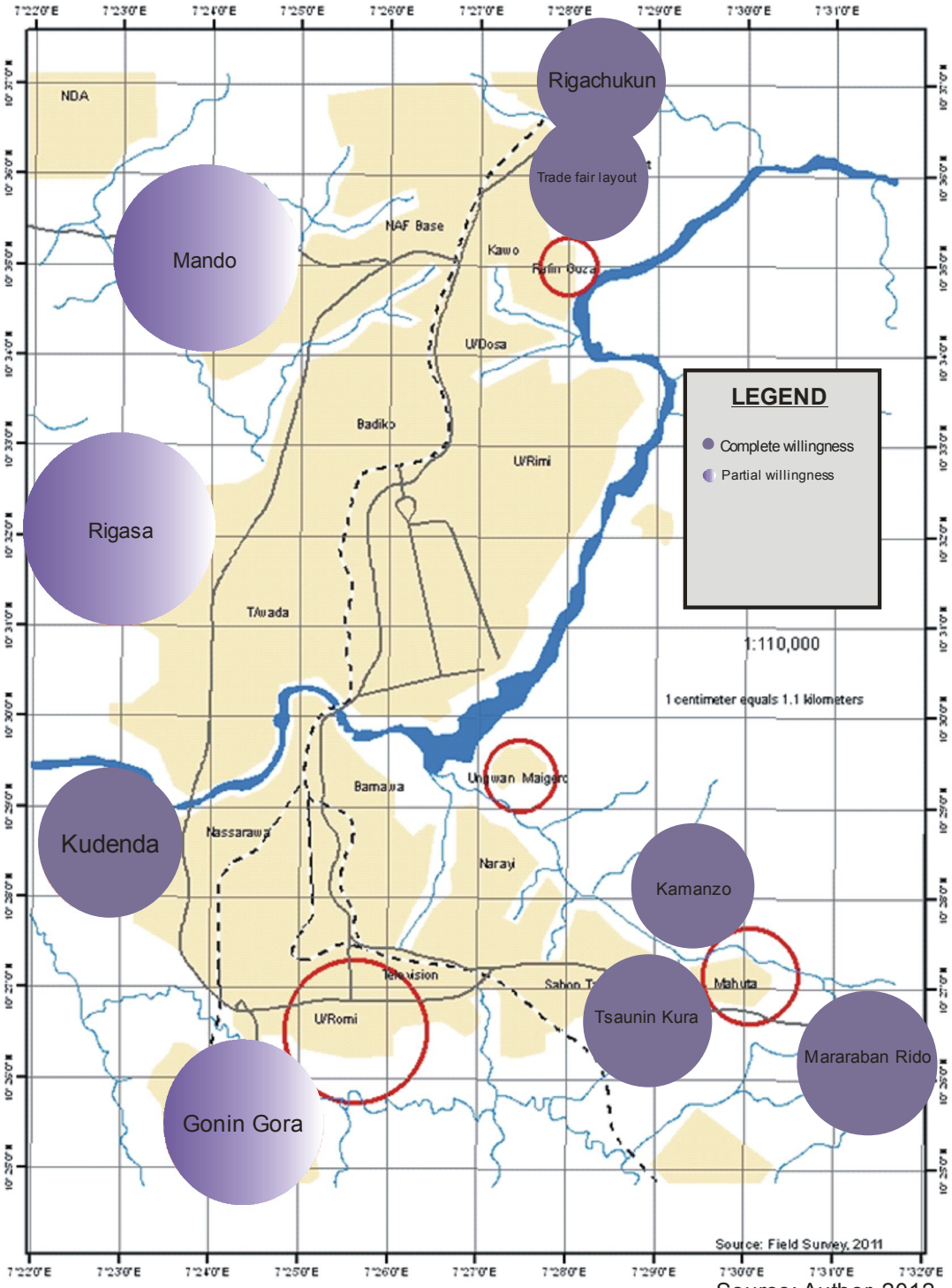
Since there is general dissatisfaction with current sources of water supply. The study went further to explore interest for pipe borne water. Households are predominantly have interest in pipe borne water supply as shown in table 5.1. The reason for high interest is because only Tsaunin Kura that fully receives pipe borne water supply. High water demand, as well as the expensive nature of water purchased from vendors are reasons for high interest in pipe borne water. Residents equally, have the understanding that payment of monthly water bills is by far cheaper than buying water from vendors. Dissatisfaction with the current source of water supply further reinforces interest for pipe borne water. The level of dissatisfaction is higher in the dry season where water table drops too low to sustain continuous water supply from wells and some boreholes. Only 4.1% that did not indicated interest for pipe borne water supply and it can be attributed to borehole ownership and irregularity of pipe borne water supply in parts of the metropolis that receives supply.

Table 5.1: Indication of interest for pipe borne water supply

Gonin Gora	Frequency	Percent
Yes	75	96.2
No	3	3.8
Total	78	100.0
Mararaban Rido	Frequency	Percent
Yes	27	100.0
Rigachukun	Frequency	Percent
Yes	19	100.0
Rigasa	Frequency	Percent
Yes	62	92.5
No	5	7.5
Total	67	100.0
Trade fair layout	Frequency	Percent
Yes	7	100.0
Tsaunin Kura	Frequency	Percent
Yes	6	100.0
Mando	Frequency	Percent
Yes	40	93.0
No	3	7.0
Total	43	100.0
Kudenda	Frequency	Percent
Yes	14	100.0
Kamanzo	Frequency	Percent
Yes	8	100.0

Source: Field Survey,2012

The study established that Mararaban Rido, Rigachukun, Trade fair layout, Tsaunin Kura, Kudenda and Kamanzo indicated 100% interest for pipe borne water supply.



Source: Author, 2012

Fig. 4.5: Willingness to pay for Pipe Borne Water

The least interest is Rigasa, which can be explained by the failure to supply water through the existing network in the settlement.

5.2.2 Regularity of Water bill to areas with Pipe borne supply

Distribution of water bill is generally not regular in peripheral areas that receives pipe borne water supply as shown in table 5.2. About 25% of household with access to pipe borne water get water bill regularly.

Table 5.2: Regularity of Water bill

Regular	Frequency	Percent
Yes	6	25
No	18	75
Total	**24**	**100.0**

Source: Field Survey, 2012

This indicates a poor cost recovery system by the KSWB and a challenge for sustainable water supply because water production cost is not recovered.

5.2.3 Willingness to Pay for Pipe Borne Water Supply

The indication of willingness to pay for pipe borne water supply suggest good prospect for sustainable water supply. The data in table 5.3 revealed that 89.6 percent are willing to pay water bills where pipe borne water is supplied.

Table 5.3: Willingness to pay for pipe borne water supply

Willing	Frequency	Percent
Yes	241	89.6
No	18	6.7
I don't know	10	3.7
Total	**269**	**100.0**

Source: Field Survey, 2012

Field survey data revealed overwhelming willingness to pay water bills at 89.6%. This suggests good prospect for sustainable water supply because water cost can easily be recovered. The implication of this result is that pipe borne water supply to peripheral areas will not over burden the KSWB as operation cost will be recovered.

CHAPTER SIX

SUMMARY, RECOMMENDATIONS AND CONCLUSION

6.0 INTRODUCTION

This chapter covers summary of findings as established in this research. Recommendations are made in line with established results with the aim of improving water supply in peripheral settlements.

6.1 SUMMARY OF FINDINGS

The study set out to examine the characteristics of water demand and supply in peripheral settlements of Kaduna Metropolis in order to identify management challenges. Pipe borne water supply is generally inadequate and unreliable. Access to pipe borne water supply is generally assessed to be very low in almost all the peripheral settlements, despites its many advantages. Although areas with provision for pipe borne water supply are high but those that actually receives supply are few. This indicates two phenomenon that having provision for pipe bone water in an area does not mean that such settlement receives water. Pipe borne supply duration is poor with the best being 3 hours every day. The situation is attributed to shortfall in capacity of water treatment plant leading to rationing of supplies.

In the absence of pipe borne water boreholes are predominant source of water supply in the settlements through water vendors. Although borehole water is considered good for direct human consumption, but can easily be contaminated through the process of fetching and selling y vendors. Supplies through vendors is expensive with monthly average of ₦11,700 when compared with the average water bill paid by those with access to pipe borne water supply in the

metropolitan core which is ₦ 1,370 per month. Water vendors despite being considered expensive and unsafe medium of water supply has remained relevant medium due to high water demand. The practice of vended water has created a means of livelihood to both borehole owners and vendors alike. This situation is mostly practiced in Rigasa with the potential of meeting interim water demand of peripheral settlements.

Dug well water is the second major source of water supply in peripheral settlements of Kaduna Metropolis despite its disadvantages of being shallow and prone to contamination. This source of water supply is useful due to high water demand that must be met through the most affordable means. It cost less money to dig up a well than it is to sink and maintain a borehole.

The study established that the quantity of water used by households per day is 400 litres. It also revealed that due to difficulty in accessing water households consumes less water than the recommended UN minimum requirement. It can be categorically stated base on analysis result that residents of peripheral settlements of Kaduna metropolis overwhelmingly indicated interest in pipe borne water supply. This is explained by the advantages it has. The indication of interest leaves the KSWB with a challenge of ensuring access to all peripheral settlements of the metropolis. The overwhelming interest is as a result of low water supply and the lack of pipe borne water supply in these settlements.

The KSWB has not been effective in ensuring efficient operation cost recovery. It was gathered that only 7.1% of households that receives pipe borne water supply gets bills regularly and there is minimum enforcement of disconnection of supplies to erring customers due to cost and time need for disconnection.

There is general willingness to pay water bills by the residents of peripheral settlements of Kaduna metropolis, which cuts across settlements with and without access to pipe borne water supply. The existing consumers and potential ones indicated high willingness to pay for water supply if regular supply is guaranteed..

The challenges militating against the supply of pipe borne water supply to peripheral settlements are categorized into: Poor physical conditions; poor management of city growth and development; Socioeconomic; and Environmental challenges. All of which poses different levels of difficulty to the sustainable supply of pipe borne water to the peripheral settlements of Kaduna metropolis.

6.2 RECOMMENDATIONS

The study has shown the characteristics of water demand and supply, as well as the challenges of water supply to peripheral settlements of Kaduna metropolis. Based such findings, recommendations were developed to improve water supply situation in peripheral settlements.

6.2.1 Specific Recommendations

1. Expand the capacity of water treatment plants in Kaduna metropolis to cater for both the excess population not served and the population of peripheral areas. This is because the capacity of the water treatment plants supplying water to the core metropolis has a shortfall of 22,393,680mld and the demand from peripheral is 78,858,240mld. The total water demand of both the core and periphery is 101,251,920mld.
2. Ensuring pipe borne water supply to peripheral settlements with provisions for pipe borne water supply such as Kudenda and parts of Rigasa and Mando. Since these settlements

already have existing networks. So little investment is required to ensure supply once treatment plants capacity is enhanced.

3. Provide network to other peripheral settlements without network. This should commence with planned settlements (Trade Fair Layout) because provisions are made for service right of way and does not require compensation to any property owner in order to pave way for water supply network. Then extension of network of pipes to those settlements not planned and without network such as Mararaban Rido and Kamanzo.

4. Provide public boreholes to supplement the shortfall in pipe borne water supplies and in areas without access to piped water. Public boreholes are in high demand at the moment in Mararaban Rido and Kamanzo because these settlements have the highest percentages of dug wells. Provision should equally be made for turnaround maintenance of public boreholes through community involvement in the maintenance of public owned boreholes.

5. KSWB should prepare water distribution plans for new areas with adequate cover of developments within the radius of 50km of the metropolis. This can be achieved through good working relationship with the KASUPDA and other relevant agencies.

6. Increased funding be allocated to the KSWB in addition to internally generated revenue in order to enable the board undertake water projects in new settlements through the extension of water distribution lines and to ensure there is water supply through the network. Proper distribution of water bills to areas with pipe borne water supply and enforcement of disconnection order to erring customers.

7. The use of dug wells should be discouraged especially in the urban areas where potential pollutant abound. It is recommended for a dug well to be located within a distance of about 60m radius to soak away, septic tank and pit latrine in order to reduce water contamination through underground seepage. Since it is difficult to find this distance between dug wells and sources of contamination due to the standard plot sizes in the metropolis is 50 x 100 ft (15 x 30m).

8. Construction of additional earth dam and water treatment plants to provide adequate raw water into treatment facility to enable pipe borne water supply to areas where growth and expansion is focused along Mararaban Rido and Kamanzo. The dam to be constructed will also cater for developments that will spring as result of the construction of the eastern bye-pass.

9. Efficient and effective cost recovery mechanism be put in place by the KSWB to areas that receives pipe borne water supply and potential areas in order to increase operational revenue of the board. This is because peripheral settlements have the ability and willingness to pay for water supply by the KSWB. This has the potential of reducing daily expenditure on daily water consumption and will provide money required to meet other needs or even savings.

6.2.2 General Recommendations

1. A comprehensive land use plan should be prepared to cover the entire extent of the metropolis and make provisions for future growth points. Residential development should not be allowed without preparation of layout, which provides adequate service right of way for ease of utility extension. Water supply plan should also be comprehensively

prepared showing pipe corridors in districts, and neighbourhoods. Authorities responsible for managing urban growth and expansion (KASUPDA, MW, MLSCP and PHCN) should develop a working relationship to ensure urban development conforms with global best practices.

2. Existing peripheral settlement should be given legal recognition with minimum requirements and procedure in order to remove development restrictions placed on them hindering the extension of services. When developments in these settlements are recognized within the ambits of the law, it provides platform for individuals to access funds required to improve the quality of their properties.
3. Effort from the settlements should be made to form Community Base Organization, which provides common front for community needs that are considered beyond individual undertaken. This will ensure extension of utilities to peripheral settlements at cheaper cost than when the financial burden is to be undertaken by an individual.
4. Unplanned Settlements growth should be discouraged, through planning and making provision for city expansion and enforcement of development control measures.

6.3 CONCLUSION

The research provided useful information on water supply and demand in peripheral settlements of Kaduna metropolis as basis for identifying problems and prospects for sustainable water supply. Thirteen settlements were identified and nine were studied with results discussed above. Sustainable water supply achievable through capacity increase of the treatment plants and dams, then extension of distribution infrastructure to new areas. Without which water supply will still remain a challenge in these areas.

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Appendix I

DEPARTMENT OF URBAN AND REGIONAL PLANNING
AHMADU BELLO UNIVERSITY, ZARIA

M.SC URBAN MANAGEMENT RESEARCH

This questionnaire is being administered as part of M.Sc research at the Department of Urban and Regional Planning, ABU Zaria on **"Urban Management Challenges for Water Supply in Peripheral Settlements of Kaduna Metropolis"**. All information provided will be treated confidentially and solely used for the purpose of this research only.

Damina B. G. *(08156352260)*

Settlement Data

Name of Settlement : Gonin Gora

How old is the settlement…….

Section 1: *Household Profile*

1. Family Size: (1). 1 – 4 ( ) (2). 5 – 8 ( ) (3). 9 - 12 ( )
   (4). 12 and above ( )
2. Occupation: (1). Civil servant ( ) (2). Business ( ) (3). Farmer ( )
3. Family Monthly Income: (1). ≤N18,000 ( ) (2) N19,000 - 36,000 ( )
   (3). N37,000 – 54,000 ( ) (4). N55,000 – 72,000 ( )
   (5). N73,000 – 90,000 ( ) (6). ≥ N 91,000 ( )
4. Number of families in your compound? (1). 1 family ( ) (2). 2 families ( )
   (3). 3 Families ( ) (4). 4 families ( ) (5). Above 4 families ( )
5. Type of House Occupied (1). Rooming House ( ) (2). A flat in a compound of flats ( ) (3). One family property ( )
6. Are you the owner of your house? (1). Yes ( ) (2). No ( )
7. Do you have tenants in your house? (1). Yes ( ) (2). No ( )

Section 2: *Water Supply Characteristics*

8. Is your area connected to pipe borne water supply network? (1). Yes ( ) (2). No ( )
9. If yes, how did you secure connection? (1). Government ( ) (2). Community effort ( )
   (3). Wealthy individual ( )
10. What is your major source of water supply? (1). Pipe borne water ( ) (2). Well ( )
    (3). Borehole ( ) (4). River/streams ( )
11. If answer to question 10 is borehole, who sunk it? (1). Local Government ( )
    (2). Individual on Commercial basis ( ) (3). The community ( )

(4) Private Individual ( )

12. If source is pipe borne water, tick the appropriate water supply duration

	Duration of public water supply	
1	24 hours of the day	
2	Few hours in a week	
3	Few hours in 3 days of a week	
4	Few hours in 2 weeks	
5	Few hours in one month	

13. If source is pipe borne water supply, where do you fetch water?
(1). Within my Family building ( ) (2). Yard Tap ( )
(3). Public tap outside my yard ( )

Section 3: *Demand Characteristics*

14. Estimate the distance covered to fetch water. (1). < 1 km ( ) (2). 1 – 2 km ( ) (3). 3 – 4km ( ) (4). Above 4km ( )

15. Approximate the quantity of water your family use in a day? (1). 1- 5 of *20 litres Jars* ( ) (2). 6 – 10 *of 20 litres Jars* ( ) (3). 11- 15 of *20 litres Jars* ( ) (4). 16 – 20 *of 20 litres Jars)* ( ) (5). Above 20*(20 litres Jars* ( )

16. Do you buy water from water vendors? (1). Yes ( ) (2). No ( )

17. If yes, how much do you buy 1 Jar of 20 litres of Water? (1). < N20 ( )
(2). N20 – 40 ( ) (3). Above 40 ( )

18. Do you queue when fetching water? (1). Yes ( ) (2). No ( )

19. If yes, estimate the time spent when queuing to fetch water? (1) < 10 minutes ( )
(2). 11 – 20 minutes ( ) (3). 21 – 30 ( ) (4). Above 30 minutes ( )

20. User Satisfaction survey of current water supply
(If available please tick Yes and if not tick No; and grade their conditions as appropriate)
(6) Very satisfied (5) Satisfied (4) Not satisfied (3) Very unsatisfied

Question	1 Yes	2 No
Are you satisfied with your current source of water supply		
Does your current water supply meets your daily water needs in dry season?		
Will you want your house to be supplied with pipe borne water?		

Section 4: *Prospects for Sustainable supply*

21. If your house is connected to pipe borne water system, do get your water bills regularly? (1). Yes ( ) (2). No ( )

22. If your house is not connected, are you willing to pay if pipe borne water is supplied to your house?
(1). Yes ( ) (2). No ( ) (3). I don't know ( )

Section 5: *Dynamics of Population*

23. Did you relocate to this area? (1). Yes ( ) (2). No ( )

24. If yes, when did you relocate (1). 1- 5 years ago ( ) (2). 6 – 10 years ago ( ) (3). 11 – 15 years ago ( ) (4). 16 years and above ( )

25. Where were you staying in Kaduna……..

26. Please give reasons for Relocation (1). Build my own house ( ) (2). Rent is cheaper ( ) (3). Because of crisis in the City ( ) (4). Others *(please specify)*……

Thank you