PLANNING FOR DOMESTIC WATER SUPPLY IN MUGUTHA SUBLOCATION OF RUIRU MUNICIPALITY IN KENYA

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DECLARATION

This work is my original work and has not been presented for a degree in any other university

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DEDICATION

To my nucleus family members:

My wife- Janet for her love and support;

My son Newton for his inquisitiveness; my daughter

Fridah for her concern about my academic homework

and

Linet for her innocence

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It is a matter of fact that this Thesis has undergone a metamorphosis since the idea of undertaking a research in the field of resource management was conceived, through the formulation of the problem to data collection and analysis and finally report writing. Through this learning and research process, I have received critiques, encouragement and support from a host of people and institution, some from the least expected quarters. It is to them all my gratitude goes. Without their involvement and at times engagement, I could have easily lost the drive to make a modest contribution to the pool of knowledge in the ever knowledge-deficient world of development planning.

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ABSTRACT

The Kenya natural endowment of freshwater is limited. It is estimated that currently only 15 per cent of the country's potential yield of renewable fresh water resource has been developed. Currently, access to safe water at national level is estimated at 68 per cent in urban areas and 49 per cent in rural areas with the overall coverage and access declining in terms of quality and quantity. Presently, the national coverage of safe drinking water is estimated at only 40 per cent

Rapid urbanization in urban fringe areas stress the capacity of existing infrastructure facilities and compromises the ability of the government and other agencies to provide essential urban services, critical among them being domestic water supply. Attempts to mitigate these problems have often been ineffective in space and time. Lack of clear policies and effective legal and institutional mechanisms posses a major challenge to sustainable urban development in urban fridge areas. The effect of Nairobi city urban sprawl, rapid unplanned growth and informal settlement in Ruiru municipality has put high pressure on the capacity of Ruiru Municipality water infrastructure.

This study examines the existing domestic water situation in the fast urbanising Ruiru municipality in general and Mugutha Sub-location in particular with a view to making viable proposals on how water demand can be met in an equitable and sustainable manner within the framework of Integrated Resource Planning (IRP). Secondary and primary data were collected using appropriate instruments. The statistical package for social sciences (SPSS) was used to analyse field data while Excel was used to aid better graphical presentation. Geographic Information System (GIS) was used for spatial analysis.

The study found out that the main sources of water in the study area were surface water, ground water and precipitation. Since the municipal authority is not a water undertaker, the domestic water supply has been left to various water services providers. The study further found out that the peri-urban area of Mugutha sub-location is largely rural in nature with limited commercial and industrial activities. About 86 per cent of respondents' houses were permanent in nature. Over 40 per cent of the respondents work in Nairobi and use various modes of transport to access their work places, however, poor

roads and drainage systems hampers mobility. The study found out that the majority of households (71 per cent) are not connected to piped water supply. This situation contributes to low piped water coverage and poor equity of distribution in addition to relatively low adequacy levels. The frequency of domestic water supply for those households that are connected is rather discouraging as only 38 per cent receive their supplies on daily basis. In the study area this study established that the main mode of excreta disposal is use of pit latrines. About 80 per cent of the respondents indicated that pit latrine was the only available mode of excreta disposal as adaptation of other alternative modes depends on a reliable supply of piped water.

The study concludes that the level of domestic water supply coverage is low and the distribution is not equitable. It is against this background that planning for domestic water development and supply becomes an inevitable undertaking. Prudent water demand management within the framework of Integrated Resources Planning is advocated for sustainable development of the study area in particular and Ruiru municipality in general.

Some of the recommendations made in the study include: Prudent water demand management must be exercised through tariff and water saving measures such as protection and conservation of water resources. The role of community water supplies and water vendors should be enhanced and regulated to promote equitability and quality water provision in the study area.

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List of Acronyms

DURP - Department of Urban and Regional Planning
WRMA-Water Resources Management Authority

WSRB -Water Services Regulatory Board

WSB -Water Services Board

WSP -Water Service Provider

CBO -Community Based Organization

G.I.S -Geographic Information System

SPSS -Statistical Package for Social Sciences

IWRM -Integrated Water Resource Management

IRP -Integrated Resource Planning

WDM -Water Demand Management

WSS -Water Supply and Sanitation

AWSB -Athi Water Service Board

CHAPTER ONE

INTRODUCTION

1.0 Introduction

The typical social economic characteristic of urban fringe areas Africa is poverty, unemployment and deficiencies in housing and infrastructure. The diversity and complexity of the urban problems in fast urbanizing municipalities tend to increase in peri-urban areas within metropolitan sphere of influence. Lack of effective planning and weak development control aggravate the situation in developing countries including Kenya. Rapid urbanization in peri-urban areas has stressed the capacity of the existing infrastructural facilities and compromised the ability of the government and other agencies to provide essential urban services include domestic water supply. Developing countries, especially in the Sub Saharan Africa lack effective means of mitigating these constraints. Lack of clear policies and effective legal and institutional mechanisms are among the key challenges to sustainable urban development facing these countries.

Basic services such as water supply, sewage disposal, surface drainage and refuse collection are important in providing a health environment. Out of these basic services, water supply and sanitation are probably the most important because it impacts on all sectors in development. Other than domestic use, water supply is essential for agricultural, industrial transport as well as recreational activities. To underscore the importance of water supply and sanitation services, a special session of the United Nations General Assembly declared the 1980–1990 the international decade for drinking water supply and sanitation. A convenient supply of safe water and the sanitary disposal of waste are essential ingredient of a healthy productive life. Water is also an essential resource for both social and economic growth of a country.

Despite the important role in the development of a country, water as a resource is poorly distributed in space and its provision is not only inadequate but also inequitable in term of quantity and quality. About 97 per cent of the earth's water is salty while most of the fresh water is locked in glacier and polar ice caps (East African Standard, World Water

Day Supplement, March 26, 2006). A country's natural endowment of freshwater is therefore limited in majority of these countries. In this regard sources of water for domestic use are highly limited in terms of adequacy, equity and sustainability. The annual water availability per capita in 2003 stood at 647 cubic metres and is projected to 235 cubic metres by 2005. This is far below the standard 1000 cubic metres per capita set as the benchmark for water scarcity (East African Standard, World Water Day Supplement, March 26, 2006).

In Kenya, it is estimated that only 15 per cent of the potential yield of renewable fresh water resource has been developed. This low level of development implies declining per capita capacity due to increase in population and as a result of poor management of water resources. Currently, access to safe water at national level is estimated at 68 per cent in urban areas and 49 per cent in rural areas with the overall coverage and access declining in terms of quality and quantity (Ministry of Water and Irrigation, 2005, National Water and Sanitation Strategy Paper). The Athi River Basin under which the proposed study area falls presented a water demand of 870,000 cubic metres per day in 2000, which is projected to increase to 1,340,000 cubic metres per day in 2010 in the urban areas (GoK, 1992).

Water resources development contributes enormously to economic productivity and social well being of the human population. With the increasing population, urbanization and other socio economic processes, the pressure on limited water resources is becoming unbearable, inadequate, unreliable and of questionable quality. This has led to over exploitation of water resources for domestic, irrigation and industrial purposes. The ever-rising demand for water use has produced corresponding amounts of domestic and industrial effluent; agricultural and urban run off. This is polluting the environment in general and water resources in particular.

Rapid unplanned growth and informal settlement fuelled by urban sprawl in Nairobi have put high pressure on the capacity of Ruiru Municipal Council water infrastructure to provide water services (Traska et al, 2006). Urbanization processes in Nairobi city region of which Ruiru is part of exerts pressure both on infrastructure and agricultural land in Ruiru municipality (Traska et al, 2006). This has led to rampant land subdivision

in the urban fringe to small and relatively cheap parcels that attracts people from both rural and urban areas, mainly from neighbouring rural districts.

Within Ruiru Municipality where the municipal authority is not a water undertaker, the domestic water supply has been left to various water services providers that include private borehole owners, water vendors, ministry of water and community based water projects (DURP, 2005). The expansiveness and the nature of sparse settlement make the provision of this vital service to the municipal residents a difficult task. Low coverage and inequitable water distribution are likely to widen government efforts of making domestic water accessible to urban dwellers.

Population growth, agricultural expansion, urbanization and industrial development are major challenge to water resources management as a result of land degradation and water pollution. In the study area, water is used for (i) domestic (ii) industrial and (iii) agricultural activities including irrigation. Rampant use of pit latrines, lack of proper solid waste management, and lack of reticulated sewerage system are potential sources of direct pollution to water resources in the study area.

1.1 Reforms in the Water Sector and the Domestic Water Supply

Overall, development expenditure on water supplies and related services increased by 88.4 per cent from Ksh. 2.4 billion for 2002/2003 financial year to Ksh. 4.4 billion for 2004/ 2005 financial year, largely due to increased funding from development partners (GoK, 2004a, 2004). According to the survey, the ministry of water is responsible of ensuring that all Kenyans have access to safe drinking water within reasonable walking distance. It is estimated that about 78 per cent of the urban population and 50 per cent of rural population had access to safe drinking water by 2003. However this proportion is reducing rapidly due to increase in urban population without adequate water resources and poor maintenance of water supply network (GoK, 2004a,).

The Government of Kenya provides water infrastructure and other services through annual budgetary allocation in the form of Development Expenditure. Finance for water and other infrastructure services are also sourced from International Monitory Fund

(IMF) and World Bank (WB). The table below present the situation of National Government's Development Expenditure for the years running between 1999 and 2004.

Table 1-1: Development Expenditure on Water Supply and Sanitation Services 1999-2004 (Ksh., 000)

Financial Year.	1999/2000	2000/2001	2001/2002	2002/20003	2003/2004
Water Development	450,739	329,535	410,444	661,698	934,772
Rural Water Supply	53,938	68,632	175, 099	261,515	586,036
Urban Water Supply	4,608	13,088	322,258	325,500	1,548,600

Source: Kenya, Republic of (2004) The Economic Survey, Ministry of Planning and National Development, Government Printers, Nairobi.

The dramatically increased funding to Rural and Urban Water Supplies Programmes in the year 2004 is due to the ongoing reforms in the water sector including rehabilitation of water supply projects to the communities and commercialisation in line with the Water Act 2002 (Kenya, 2002).

Over the last 3 decades funding for rehabilitation, upgrading, and expansion of water supply and sewerage facilities was inadequate (Kenya, 2005). In reaction to this, the government, in 1989, initiated a process of reforms in the entire water sector also focusing on poverty reduction. The government also published the Sessional Paper No 1 of 1999 on National Water Policy on Water Resources Management and Development (Kenya, 1999). The policy paper has since provided enabling framework in dealing with issues pertaining to water resources management, water and sewerage development, and institutional development and financing of the water sector (Kenya, 1999). The Sessional Paper No.1 of 1999 also provides for adequate water supply to meet basic needs and to ensure safe wastewater disposal.

In 2003, the government of Kenya formulated the Economic Recovery for Wealth and Employment Creation (ERWEC) that recognizes that the institutional arrangements are inappropriate and proposes to undertake comprehensive institutional reform to implement " pro- poverty water and sanitation programmes." Among the key reforms proposed include: implementation of private sector participation and development of models for distribution of water and sanitation services to the poor.

The objectives of the National Water and Sanitation Strategy are to ensure that adequate domestic water is accessible for both rural and urban areas. Recently, the government of Kenya formulated the National Water and Sanitation Strategy (NWSS) (Kenya, 2005). The strategy has adopted certain principles such as the need to separate policy and regulatory functions from service provision; treating water services as social and economic goods; linking water supply to sewerage management and development; linking water services to the economy, and promoting established standards of water service delivery (Kenya, 2005).

It is on bases of these legal provisions, policy strategies and principles discussed above that this study seeks to undertake research on 'Planning for Domestic Water Supply in Mugutha Sublocation of Ruiru Municipality in Kenya'. Specifically, the strategy hope to increase the urban water supply from the current estimated coverage of 68 per cent to 84 per cent by 2015 in line with the Millennium Development Goals (MDGs) (Kenya, 2005). MDGs require that the proportion of people without sustainable access to safe drinking water should reduce by half in 2015. The study therefore aims to enhance the achievement of this target in Ruiru municipality.

1.2 Planning for Domestic Water Supply and Sustainable Development

Water supply in urban and peri-urban areas creates bottlenecks to sustainable development. Conflict among competing water users and sectors contribute to increased poverty and declining economic performance. Water scarcity, depletion and high water demand has caused irregular and inadequate domestic water provision in urban areas of Kenya. This, together with inadequate financial resources, mismanagement of water

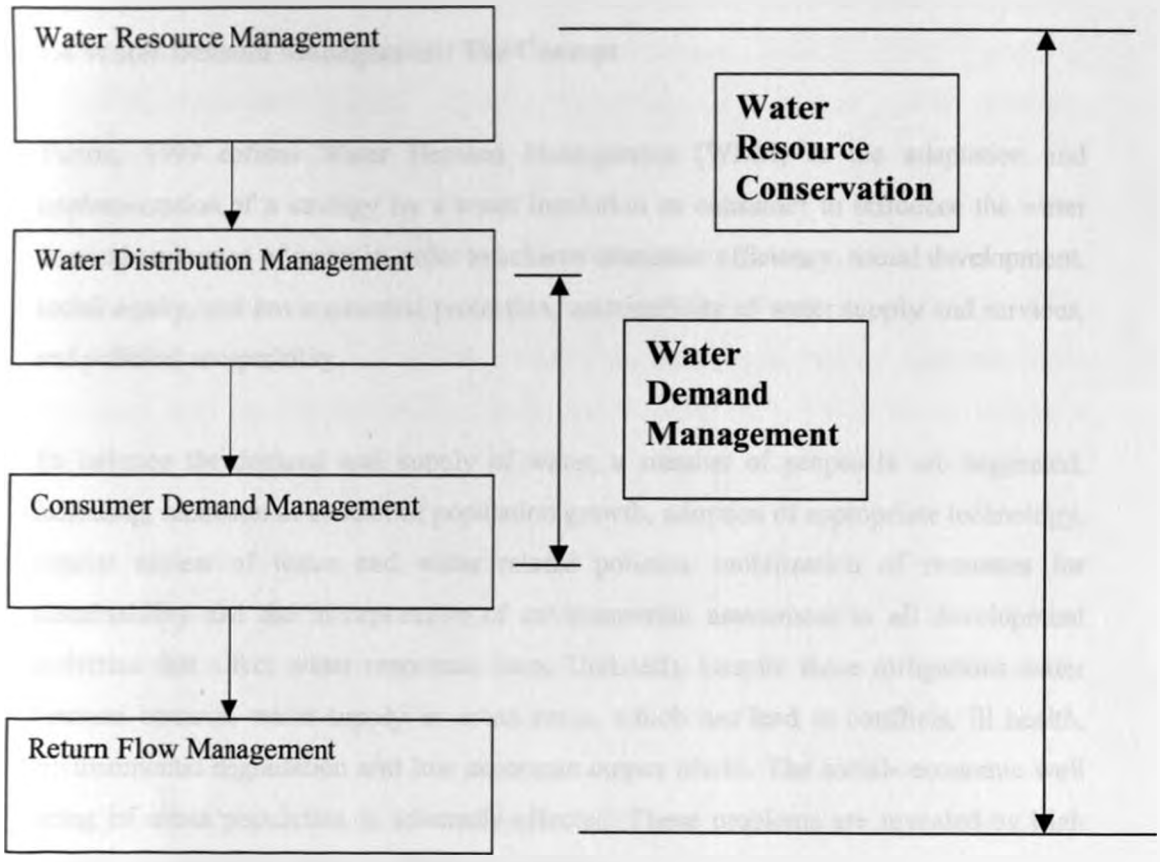
resources, and weak regulatory mechanisms has resulted to degradation of environment, declining socio-economic fortunes and political protests in the rural and urban areas. In this regard planning for effective water supply and better sanitation is key to providing basic services.

The World Bank has acknowledged that in order to achieve the twin objectives of economic growth and poverty eradication the poor must not only be assisted to increase their productivity but also their access to essential public services must be assured. Of these, domestic water supply and sanitation provision are critical especially among the urban poor. Consequently, effective planning and management of these services is crucial for sustainable urban development.

1.3 Integrated Resource Planning

Turton, 1999 defined Integrated Resource Planning (IRP) as a way of analysing the change in demand and operation of water institutions that evaluates a variety of supply-side and demand-side management measures to determine the optimal way of providing water services. From this definition IRP is a process of determining the appropriate mix of demand-side and supply-side resources that are expected to provide long-term reliable service to users at the lowest reasonable total cost. IRP focuses on the integration of a several criteria including water resources, environmental, financial management and social progress (Turton, 1999). IRP aims at achieving the desired outcome by integrating various options in reconciling water resource demands and requires the planning integration of the entire water supply chain. Figure1-1 represents a holistic water supply chain in the context of IRP.

Figure 1-1 The Holistic Water Supply Chain



Source: Turton, (1999) Water Demand Management: A Case Study from South Africa, Page13, MEWREW Paper No. 4, School of Oriental and African Studies.

Altough IRP is not a completely new concept it has some advantages over traditional planning practices. For instance, IRP is result oriented unlike the traditional planning practice, which focuses on the best-perceived solution of an institution perspective. Under IRP framework water demand-side management measures are considered as an alternative resource option and not a separate campaign (Turton, 1999). Another important aspect of the principles of IRP is the need to look at the water supply chain in a holistic way. This requires co-ordination and co-operation by all utilities and organisations in the supply chain. The IRP can only be achieved, however, through partnership and customer focus (Turton, 1999). Hence sustainable IRP approach calls for coordination and integration between and across different stakeholders while

participation by concerned parties is a key element in achieving efficiency and cost effectiveness.

1.4 Water Demand Management: The Concept

Turton, 1999 defines Water Demand Management (WDM) as the adaptation and implementation of a strategy by a water institution or consumer to influence the water demand and usage of water in order to achieve economic efficiency, social development, social equity, and environmental protection, sustainability of water supply and services, and political acceptability.

To balance the demand and supply of water, a number of proposals are suggested, including, reduction or control of population growth, adoption of appropriate technology, regular review of water and water related policies, mobilization of resources for sustainability and the incorporation of environmental assessment in all development activities that affect water resources (Ben, Undated). Despite these mitigations water demand outstrips water supply in urban areas, which has lead to conflicts, ill health, environmental degradation and low economic output (ibidi). The social- economic well being of urban population is adversely affected. These problems are revealed by high poverty levels in the majority of urban population.

1.5 Problem Statement

Most urban fridge areas in developing countries exhibit certain typical social economic characteristics. These characteristics include, but not limited to lack of or inadequate provision of basic infrastructure and services. Key among those services is domestic water supply in the backdrop of rapid unplanned urbanization process. Due to fast growing population and the attendant pressure on limited resources in urban fridge areas, the capacity of local authorities to address the possible development constraints in general and domestic water provision challenges in particular is curtained by a number of possible factors. These factors range from inadequacies in policies and institutional arrangements, in sufficiency in human and technical capacity to poor economic base and governance issues within the local authority.

When the area of jurisdiction of the local authority in question in expensive and falls within the metropolitan influence of a city experiencing land and housing pressure, than the dynamics area much more fluid and complex. This is the exact description of the situation in Ruiru municipality as it relates to Nairobi city. Lack of effective planning and weak development control aggravates the situation in Ruiru municipality generally and Mugutha sub-location specifically.

In Mugutha sub-location, such basic services as domestic water supply, waste water disposal solid waste management and maintenance of surface drainage are inadequately planned for, insufficiently provided for and inequitably supplied by both the Rural municipal authority and stakeholders Mugutha, sub-location, just like Ruiru Division a perfect residential dormitory of Nairobi city and other urban centres including Kiambu and Thika. Rapid unplanned growth, fuelled by urban spiral in Nairobi and Ruiru's more dense settlement areas such a Githurai, Kimbo have put enormous pressure on the capacity of the municipal authority and other service provide to provide adequate and reliable domestic water to Mugutha residents. The situations of in adequate water supply is made worse by the fact that Ruiru municipal council is not a water service providers ad the few water service providers that operate within the municipality poorly serve Mugutha sub-location in terms of meeting the water demand, the reliability and equity of supply. The expansive and linear in nature of the rural-urban study area makes the provision of piped water supply expensive and inequitable. This unfavourable situation impacts negatively on wastewater disposal in the study area as the majority of residents use pit latrines as the main mode of excretal disposal.

From a reconnaissance conducted earlier and also from previous studies, undertaken in the study area, Mugutha sub-location is inadequately served with domestic water despite the existence of various sources of water that exists from within and without the sub-location. These sources include ministry of water supply (The Athi Water Service Board), Nairobi city council supply (Nairobi Water and Sewerage Company), private bore holes operators and a number of rivers and streams. Dams, shallow wells and roof catchments are also valuable sources of water. However, the possibility of water pollution is real taking into account the various competing and sometimes conflicting water uses in Mugutha conflicting water uses in Mugutha and its immediate environs. Industrial discharge and wastes, urban and agricultural turn offs and widespread use of

pit latrines and shallow wells could all be possible sources of surface and ground water pollution. These dynamics among other factors make sustainable development and supply of domestic water in Mugutha sub-location difficult to achieve in line with development goals unless prudent planning interventions are put in place

This case study therefore aim at examining the existing situation and projecting the future status of domestic water supply in Mugutha Sub-location of Ruiru Municipality. The critical aspects of sustainable municipal water supply to be studied and analysed include: adequacy of supply in terms of quantity and quality; equitability of supply with regard to coverage and distribution; and issues of sustainability of supply sources. Factors affecting efficient and cost effective provision of these services will be investigated in order propose an integrated approach of addressing the constraints and enhancing the resource potential of the study area within the framework of Integrated Resource Planning. The entry points in the study include Water Sector Reforms, Water Demand Management, and Sustainable Development. The study looks at water as both a resource and a service.

1.6 Research Questions

1. What are the existing and potential sources of domestic water supply and their levels of demand versus supply in Mugutha sub-location of Ruiru Municipality?
2. What constraints exists that may hinder sufficient and equitable domestic water supply to the residents of Mugutha sub-location
3. How can the identified constraints be addressed to enhance efficiency and cost-effectiveness in domestic water supply in Mugutha sub-location?

1.7 Objectives

The study will achieve the following objectives

1. To identify existing and potential domestic water sources in Mugutha sub-location
2. To determine the level of demand versus supply of existing water supply in Mugutha sub-location

3. To find out the possible constraints hindering sufficient and equitable domestic water supply to the residents of Mugutha sub-location; and
4. To propose and recommend measures that could enhance efficiency and cost effectiveness in domestic water supply in Mugutha sub-location of Ruiru Municipality.

1.8 Study Assumptions

1. The domestic water demand in Mugutha sub-location far outstrips the available supply; and
2. The capacity of Ruiru Municipal council in its current form is inadequate to address the constraints, which hinder sufficient and equitable domestic water supply in Mugutha sub-location

1.9 Justification of the Study

The sectoral approach to planning for urban domestic water supply that has been adopted and applied in the past has not worked well in urban fridge areas. Lack of adequate funding insufficient institutional framework and lack of coordination among and within actors in water sector has led to a situation of inadequate supply where urban water demand outstrip supply; in equitability in coverage and supply, lack of sustainability in operation and maintenance and vandalism and illegal connections due to poor governance. Conflicts among and between competing and sometime conflicting uses and users are common in the study area resulting to poor service delivery depressed economic performance and therefore exaltation of urban poverty. Hence, there is need to adapt and adopt a more integrated approach in planning of water resources, water supply and managements of the same for sustainability. Integrated resource planning flow encompasses water resources conservation and water demand management is such as an ideal integrated approach. I RP promote coordination and partnership and enhances the application of appropriate technology and it also accompanies the need for environmental assessment so as to achieve economic efficiency social equity and environmental integrity.

If IRP approach which this study promotes and advances result in sustainability in domestic water supply in Mugutha, then the residents of Mugutha especially and Ruiru municipality in general will enjoy improved standards of living is an environment of social economic and political program. The findings of this study and the ensuring recommendations would provide useful data/information as to the main sources of domestic water supply in Mugutha sub-location and the nature character and extent of this supply so as to better conceptual use the demand-supply situation. The identification of possible constraints, challenges and potentials to effective and efficient domestic water supply in Mugutha sub-locaation and the policy recommendations should be useful to water service providers, water service board and other institutional establishment in the water sectors. Members of pubic, business community farming community planning professional and academic and the Ruiru municipal council will definitely benefit from this research. The finding and recommendation, contained in this these will surely prove to be important base line information in the preparation of a municipal physical, and even strategic plan for better service delivery in its area of jurisdiction.

Sustainable use of water resources to meet the needs of a growing urban population cannot be achieved without a better understanding and a careful management of urban water demands. The geographic concentration of urban water demands creates a major challenge for water resources planners who must establish reliable sources of water supply to meet ever-increasing needs (Ben, undated).

The dynamics of population growth, human settlement development, land use changes and urbanization continues to exert, much pressure on urban water infrastructure and services. This situation is even more complicated in fast urbanizing municipalities within the spheres of influence of metropolis such as Nairobi. Currently, access to safe domestic water sources is estimated at 68 per cent in urban areas. The domestic water supply in Ruiru municipality generally and Mugutha Sub-location in particular has problems as a result of inadequate planning and funding. The ministry of water supply or private water providers poorly serves Mugutha Sub-location. Mugutha Sub-location is largely a peri-urban area of rural–urban nature, hence urban agricultural activities exerts significant pressures on available domestic water sources and supply. The need to plan for the development of water resources, equitable and sustainable supply of domestic water use in Mugutha sub-location is more urgent because Ruiru Municipal Council has not put in

place a requisite policy framework to promote and guide domestic water supply in the study area.

1.10 Scope of the Study

In this study water is treated as a resource and a service. From the household perspective, it is artificial to classify a source of water as purely for drinking, personal hygiene and domestic use; or merely for irrigation. At the household and even community levels in the peri-urban communities water is viewed holistically. Whatever the sectoral context which water providers serve the people in urban fridge, the IRP is the dominant view point as far as water is concerned.

Though much of current literatures in the field of study do not separate water and sanitation issues, this study does not concern itself with matters of sanitation outside household level. The geographic extent of the study will be limited to Mugutha sub-location only. Areas still covered by coffee plantations will be exempted from the study, as their resident population are very low. The concept of Integrated Resource Planning is also used in this study in a limited scope and focuses on integration of surface water and groundwater resources in Mugutha sub-location.

1.11 Operational Definition of Terms

1. Peri-urban Area

Peri-urban refers to an initially unplanned informal or formal settlement within the area of jurisdiction of a Local Authority. Many peri-urban areas are characterised by a high incidence of poverty, high population densities, their unplanned appearances, and inadequate or non-existent basic services (such as water supply, sewerage, roads, storm water drainage and solid waste disposal (DTF, 2005)

2. Water Conservation

Water Conservation (WC) is the minimization of loss or waste, care and protection of water resources and the efficient and effective use of water.

3. Water Demand Management

Water Demand Management (WDM) can be defined as the adaptation and implementation of a strategy by a water institution or consumer to influence the water demand and usage of water in order to meet any of the following objectives: economic efficiency, social development, social equity, and environmental protection, sustainability of water supply and services, and political acceptability.

4. Integrated Water Resources Management

Integrated Water Resources Management (IWRM) is defined as a process, which promotes the coordinated development and management of water, land and related resources, in order to maximise the resultant economic and social welfare in equitable manner without compromising the sustainability of vital ecosystems. Integrated Water Resources Management (IWRM) aims at striking a balance between the use of resources for livelihood and conservation of resources to sustain its functions for future generations. The definition of IWRM embraces economic efficiency, environmental sustainability and social equity.

5. Poverty

In socio-economic terms, poverty is defined and perceived as a condition in which people's livelihood capacity is inadequate to meet their own and child's basic needs. This could be either due to lack of access to natural resource base or because of lack of paid employment or viable entrepreneur opportunity; or because of some form of vulnerable; and additionally because of lack of access to basic services.

1.12 Organization of Thesis

This thesis is organized in six chapters each dealing with a specific aspect of the study.

Chapter One gives an introduction to the study, the research problem, research questions, research objectives and hypotheses, justification of the study, and scope of the study. The definitions of operational terms are also presented in this chapter.

Chapter Two deals with Literature review where relevant literature to the study is subjected to a critical review so as to identify the knowledge gap and give the study local, regional and global perspective. The policy direction in the field of study is also analysed.

Chapter Three presents the methodology used in the study including methods of data collection, sampling techniques, data analysis and presentation. The Limitations and challenges encountered in the field are also presented in this chapter.

Chapter Four presents the Background to the study area with the aim of relating the field of study to the demographic, socio-economic and political profile of the regional area. The resource bases of the Ruiru Municipality and Thika district are explored to assess the sustainability of proposals made in the study.

Chapter Five presents the findings and analysis of results where the key research findings and field data analysis is brought to bear with the study objectives.

Chapter six deals with summary of key findings, conclusions and recommendations made in respect of what the study had set out to find.

CHAPTER TWO

METHODOLOGY

2.0 Introduction

This section outlines the system of logically organized methods, principle and rules regulating the conduct of inquiry into the subject of study. The subject of study in this respect is planning for sustainable development of domestic water within the framework of integrated resource planning using Mugutha sub-location of Ruiru Municipality as a case study .The methodology adopted in the study include aspects of , data collection, data analysis and presentation of findings and recommendations.

2.1 Methods of Data Collection

Both secondary and primary data was collected on demand versus supply, equitability of water distribution and accessibility and sustainability of domestic water development and supply in Mugutha Sub-location. A social-economic profile of the population in the study area was developed to understand the households' characteristics. A household questionnaire was administered in this regard, which also covered land tenure and land use characteristics in the Sub-location.

2.1.1 Secondary Data

Secondary data was collected throughout the study by a critical review of the relevant literature on planning, development, and management of urban water resources and its supply for domestic use. The review included official government documents including National Development Plans 2002-2008, Thika District Development Plans 1997-2001, 2002-2008, The Sessional Paper No.1of 1999, The National Water Services Strategy 2005, The National Water Master Plan 1992, and The Water Act 2002, among others. The purpose of the review was to understand the government's official guiding policies and strategies in respect of water planning, development and management aspects in the study area. Text books, print and electronic journals, newspapers, previous research and

studies carried on urban water development and supply both within and without the study area were also important sources of relevant literature. Literature on the current global water situation and water agenda was also examined including journals relating poverty alleviation and sustainable development as hallucinated in the Millennium Development Goals (MDGs).

Literature Review proved useful in the formulation of research problem, framework of data analysis, and in making conclusions and formulating recommendations. Literature Review proved to be a cost-effective and reliable source of valuable historical and current information that offered a platform for investigating the research problem. The University of Nairobi libraries, Kenya Water Institute library and Ministry of Water library also proved very useful. Finally, the electronic journals also proved dependable source of current literature.

2.1.2 Primary Data

First, reconnaissance tour of the study area was conducted in order to assess the relevance of the questionnaires and estimate time and cost of field data collection. Second, the actual data collection was done using household questionnaires, scheduled interviews with key informants, informal discussions, direct observations and photography. A total of 75 household questionnaires were designed for administration but only 68 questionnaires were administered. Mugutha sub-location has about 3,656 households and covers about 66 km^2 and has a population density of 199 persons per km2 A number of institutional questionnaires were also administered to institutional water service providers during the field data collection.

2.1.2.1 Direct Observation

This involved visual observation of such as aspects as Physiography, land uses, water supply coverage and distribution, colour and turbidity of water sources etc. Water point sources such as boreholes were picked by GPS. The conditions of the roads as they relate to water transport were also observed. Also observed is the mode of excreta disposal in the households to assess the possibility of ground water contamination .The nature and

pattern of settlements were observed too in order to assess the equity of water supply distribution. The house types too were observed including the level of rainwater harvesting.

2.1.2.2 Photography

Usually as a compliments method, photography was used throughout the filed data collection to capture certain phenomena relevant to the study. Such phenomenon includes the land uses, sources of water, and types of houses, condition of roads, water storage facilities, and water treatment works and general environmental condition of the study area. Photography proved to be a useful tool of data capture, which saves time and cost. Photography also enables data capture in in-accessible and even restricted areas. A digital camera was used to facilitate easier processing of data so obtained.

2.1.2.3 Interview Schedules

Non-structured and semi-structured interview schedules were used on key informants to gather in –depth data pertaining to official or expert view or position relating to water and land use. Such key informant included senior officials and councillors of Ruiru municipality, ministry of water officer in charge of Ruiru water works, Thika District Physical Planner, District Water Engineer and other district based water officers, Officials from Thika Water Supply (Thika Water and Sewerage Company), Private Water Providers, District administration officials, and Community-Based Water Projects officials. Note taking during interviews was employed so as to capture availed information not contained in the interviews schedules.

2.1.2.4 Open Discussions

Informal discussions with various stakeholders such as residents of Mugutha sub-location, the community leaders, original shareholders of Nyakinyua farm, water vendors etc. were used to gain general information pertaining to challenges and opportunities in the domestic water services, land tenure systems and land use changes, transport

problems and impacts of continued subdivision of land on domestic water services delivery.

2.1.2.5 Questionnaires

A total of 68 household questionnaires containing both structured and unstructured questions were earmarked for administration on the representative sample of households to obtain important information about the population. The questionnaires were structured to address the objective of the study. Questions relating to household characteristics and socio-economic profile of both the household head and spouse where appropriate were administered. Also contained in the questionnaires are questions pertaining to domestic water supply and services and land tenure and use. The main water sources, adequacy, equity, and distribution of domestic water were captured through these questionnaires among other instruments.

Also captured were the constraints and opportunities in the domestic water domain within the sub-location and municipality to a lesser extent. Institutional questionnaires were administered mainly through self-administration to a number of institutions, which include schools, the Paramilitary (GSU) Ruiru Base, Ruiru Campus of Kenyatta University, and health clinics in the study area.

2.2 Sampling Techniques

The study used both probability and non-probability sampling during field data collection. For the household questionnaires, systematic random sampling was used. However problems were encountered as some plots are yet to be developed and settled while in some cases the planned roads on the subdivision plans are yet to be opened up. As such the substitution was done on the basis proximity, that is, the immediate next household was picked. While every 10^{th} household home was administered in the populated west side of Thika road, only every 5^{th} household was picked in the east due to sparse nature of settlements. However problems were encountered as some plots are yet to be developed and settled while in some cases the mapped roads are yet to be opened up. As such the systematic aspect of sampling was compromised and substitution was

done. While systematic sampling was applied where every 4th commercial enterprise was picked, purposeful sampling was also done so as to pick specific commercial enterprises with significant impact on water demand such as hotels and restaurants, bars and butchers with eating places attached. Purposive sampling was also applied in institutional questionnaires and scheduled interviews.

2.3 Data Analysis and Presentation

Data analysis involves the use of different statistical methods and tools for quantitative analysis and non-empirical analysis for qualitative data. Pre-analysis procedures of data cleaning, coding, data validation were performed before comprehensive data analysis and interpretation could be executed. The Statistical Package for Social Sciences (SPSS) was the most important statistical tool used in data analysis. Excel was used in graphical presentation. Manual methods were used to analyse qualitative data while Geographic Information System (GIS) was used for spatial analysis. Measures of central tendency and other statistical analysis were executed in order to draw relationships between various variables. Tables, graphs maps and charts were generated for better presentation of the results during the analysis and interpretation, the objectives and the hypotheses of the study were brought to bear i.e. aspects of adequacy, equity and sustainability were assessed and analysed.

2.4 Limitations of the Study

The study area is linear in shape and relatively big in size (66 sq. km). The expansive area is poorly served by road and drainage networks. Since the data was collected during the rainy season when most flat areas were flooded it proved difficult and time consuming to access some households thus compromising the integrity of sampling procedures. Some substitutions were inevitable due to such reasons as poor accessibility, or non-occupancy. It was difficult to estimate the current population and hence number of households to be sampled since the last census was conducted in 1999 and a lot of development has taken place since. In absence of the household head or spouse, information obtained from servants or relatives proved disjoined and sometimes unreliable. Chemical and biological qualities of domestic water sources such as shallow

wells were in most cases not available as most owners of such wells hardly have their water tested scientifically. Since subdivision of former *Nyakinyua* land there has been no land use mapping done of the study areas and as such temporal variations were difficult to access. The intended interview schedule with *Nyakinyua* management proved elusive and as such information relating to historical background of the company, its current role, its involvement and implementation of land use planning and the status of its former water resources could not be captured directly for authenticity.

CHAPTER THREE

LITERATURE REVIEW

3.1 Management of Urban Water Demand

Management of urban water supply has captured the attention of water planners and the general public in the last decade as a promising alternative to the continuing augmentation of urban water supplies. The expansion of human settlements to previous agricultural land, the physical scarcity of high quality water sources, the depletion and contamination of groundwater sources, the difficulties in financing major water infrastructures facilities for transmission, treatment, and distribution of water, have made supply-side options less viable. The last decade of 1990s has produced marked improvements in the available know –how in planning and evaluation of demand management alternatives.

Water Demand Management (WDM) has been defined as the adaptation and implementation of a strategy by a water institution or consumer to influence the water demand and usage of water in order to meet any of the following objective: economic efficiency, social development, social equity, environmental protection, sustainability of water supply and services, and political acceptability (Turton, 1999). Water Demand Management has attracted wide acceptance as a partial solution to water supply problems in urban areas. In Malawi, for example, WDM was highly advocated in both urban and per-urban areas with positive results (Mulwafu et al, 2002).

To balance the demand and supply of water, a number of proposals have been suggested in the past including reduction or control of population growth, adoption of appropriate technology, regular review of water and water related policies, mobilization of resources for sustainability and the incorporation of environmental assessment in all development activities that affect water resources (Ben, undated). However, despite the potential benefits of water demand management, its adoption in most local authorities and national and regional water service providers remains limited. Even in urban areas WDM is where some aspects of WDM are practiced, a large section of the urban poor still lack

sustainable water services. However, WDM is likely be used widely in future because of the growing competitiveness for water resources. In particular, the growing population and increasing economic use of water such as farming, industrialization and urbanization will all exert considerable pressure on water resources.

3.2 Poverty Reductions and Integrated Water Resources Management

3.2.1 Water Supply and Poverty Reduction

Poverty reduction programmes has tended to focus more on increasing economic growth at the national level. This alone is not sufficient because it neglects the distribution of resources and incomes across the region, nation and world. Poverty reduction is a complex issue and specific actions are required in areas of employment creation and generation of income and food security. Water supply is also an important component of poverty reduction strategy, which has hitherto not been well articulated. There is evidence that good governance is a fundamental requirement for development and poverty reduction and in this connection water management and provision must be looked at from an integrated perspective for sustainability (Turton, 1999).

Access to and use of water is fundamental to human survival, health, and productivity. The indivisibility of these functions of water to support human well being lies at the heart of a holistic view of the resource and the need to assure its sustainability and that of the environment dependent upon it, for all those living today and for future generations (Global Water Partnership, 2003). It is now recognised that water in given basin like Athi is a continuum, hence its use for one purpose affects its availability or quality for others in the basin. Increasing competition and sometimes-conflicting uses give raise to conflicts and even confrontation. Indiscriminate and uncoordinated usage has also led to serious ground and surface water pollution and environmental degradation. Hence there is need for an integrated approach to water resources management, planning and development of the water resources. This need is even more urgent in the context of domestic water supply in urban and peri-urban areas of developing countries. An integrated approach allows competing claims to be moderated by well-informed and participatory political processes and economic mechanisms (Global Water Partnership, 2003). In the competition for access to and use of water, it is necessary to ensure that

those with the least leverage in society-many of whom are already without an adequate or reliable supply or means of waste –do not suffer disadvantage in the implementation of water related policies.

3.2.2 Poverty

Poverty is defined as a condition where the capacity of livelihood of a given people is inadequate to meet his or her own basic needs (Global Water Partnership, 2003). This could be either due to lack of access to natural resource base or because of lack of paid employment or and additionally because of lack of access to basic services such as health, education, water supply and sanitation.

Poverty has typically been measured according to economic criteria, using crude wealth-related indicators such as average GNP per capita, or 'below poverty line' income or consumption. Over recent years, however poverty measures have broadened to include social indicators, which include access to services such as domestic water supply. A set of social and economic targets for 2015 was agreed at the Millennium Assembly and Sustainable Development Summit as the defining parameters of a renewed onslaught against poverty. Among these targets include an all-important one of halving the proportion of people without access to safe water and basic sanitation (Global Water Partnership, 2003).

The debate concerning poverty in relation to water issues is appreciated but the debate is not yet broad enough (ibidi). There is no coherent analysis of the relationship between poverty and access of water. Although water is recognised as an 'economic good', the role of water in social economic productivity and ecosystem integrity is neglected. The analysis of poverty issues in relation to water is still weak and narrows (Global Water Partnership, 2003). Statistics on use of water in irrigation and agriculture, in industrial production, and in urban household domestic use, though available are not adequately incorporated into poverty analysis. It is essential to determine implications of major changes in land/water use patterns on urban poor in order to establish who gains and who loses in order to reduce socio-economic disparities or inequities.

3.2.3 Domestic Water Coverage and Equity

Drinking water supplies and sanitation service coverage are considered to be poverty indicators. However existing data is inadequate as far as equity considerations are concerned. Statistics from World Health Organisation and United Nation Children Fund Monitoring Programme (JMP) show levels of water supply coverage but lack to indicate operational statistics (Global Water Partnership, 2003). In some parts of the world, pressure on the resource has led to decline in water table levels and serious depletion of quantity because no attention has been paid to aquifer recharge to counteract extraction rates. This has also led to pollution and degradation of chemical quality, with intrusion of fluoride, and heavy metals or salinity into ground water. Analysis based ion IRP framework can allow equity considerations to be given a higher level of attention than has been the case before.

3.2.4 Beyond Sector Based Approaches to Water Management and Development

The management of water resources and services was, and for most part continues to be based in the separate sectoral administration of the different uses of the resource. The fragmentation means that there has been no means of moderating between competing, and high-value and low-value, demands (Global Water Partnership, 2003). The lack of understanding by different user groups- rural/urban, upstream/downstream, -about resource constrain and the need to reconcile competing claims often lead to the settlement of water related disputes in ways that are politically motivated, unscientific, and short term. As the pressure on the resources has grown, and the cost of water infrastructure have spiralled, it is urgent that countries move beyond this fragmented approach to a more coordinated and integrated one for coherence, equitability, efficiency and sustainability in water resources planning, management and development (ibidi).

3.2.5 Water Sector-led Policies, Programmes and Poverty Reduction

There exists some evidence that access to water has an impact on poverty. A recent study in the poverty stricken coastal districts of Nicaragua with over 5,000 households found that households with a well had 20-100 per cent more income than those without, and

that 40 per cent of the extra income came from garden plots and small livestock holdings managed by women. Similarly, evidence from Ghana suggests that the income of poor farmers in the per-urban area of Kumasi increased significantly with the informal irrigation of horticultural crops for local markets (ibidi).

3.2.6 A Shift from Supply to Demand Value in Water Supply

Water has always been recognised as a social good, but since the International Conference on Water and Environment held in Dublin in 1992, water is recognised as an economic good; a viewpoint confirmed at subsequent international conferences and summits (GWP, 2003). Thus, there has been a decline in international support for supply driven policies. The World Bank and others have pointed out the wastage and lack of efficiency in the construction of water schemes for which costs are not recovered from consumers and which cannot be maintained (Global Water Partnership, 2003).

In urban schemes, water wastage and illegal connection is common. The funds, institutional and regulatory capacity for managing services is not in place in majority of cases. Lack of any perception of the opportunity cost of water in alternative uses resulted in low tariffs for domestic and industrial users. However, promoting a change to demand-driven and realistically priced water supplies is difficult politically when water has been previously treated as an infinite resource- a free or heavily subsidised good. Farmers with capital resources have gone in for water-intensive crops in many dry land areas, on the basis of uncontrolled ground water extraction and depletion.

Demand-driven services are supposed to help the poor by allowing their needs to be expressed and catered for, and by putting management of services into their hands. However, allocations from the resource base are often skewed in favour of the politically dominant groups. Unless there are serious reallocations of service benefits, or significant adjustment in tariff burdens to promote equity, the least well off will continue to be disadvantaged (ibidi).

3.3 Urban Water Supply and Treatment

3.3.1 Global Water Supply Situation

According to UN Water Secretariat, water supply was by 1977 available to at least 1/5 of the world city dwellers. It was estimated that 78 per cent of urban population did not have access to safe and drinking water; However World Health Organisation statistics indicate that 75 per cent of urban dwellers in developing countries have reasonable access to clean water either through piped facilities or public stand points. In urban areas water consumption takes various forms that include domestic, typically accounting for 50 to 75 per cent of total consumption; In order to meet the consumption demands there is need to have adequate sources of supply and at the same time effective institutional management of the supply system (Fieldman 1976)

According to the National Development Plan 1994 – 1996, the Percentage of both rural and urban population served by organized water points has been increasing steadily between 1990 and 1996 (Table 2-1).

Table 3-1 The Population target to be served by Organised water Points (Per cent)

Year/Population	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
Urban population	62.5	64	65.5	66.5	68	70	74
Rural Population	42	43	43.5	44.5	48	48	50
Total	52	53.5	54.5	55.5	57	59	62

Source Hofkes, E.H (1981) Small Communities Water Supply, Netherlands, International Reference Centre For Community Water Supply and Sanitation.

The Kenya Government through the ministry responsible for water development has been responsible for overall conservation, development and maintenance of water resources and supply. Local authorities have however been expected to initiate and develop urban water supplies to serve urban residents where ministry of water or National Water Conservation and Pipeline Company is not active especially in the municipalities.

3.3.2 Treatment

Treatment is usually necessary for town water supplies. Sufficient water for a whole town is not always available from the ground and so polluted surface sources often have to be used. The larger scale of a town water supply could cause a water-borne epidemic in the whole town so that the consequences of poor water quality are more serious.

3.3.3 Coagulation and Sedimentation

Because of the high silt loads of most tropical rivers, sedimentation is usually necessary as a first stage of water treatment. This involves passing the water slowly through a large tank to allow time for solid matter to settle out. It does not significantly improve the microbiological quality of the water but makes subsequent processes more efficient. Sedimentation is usually assisted by adding chemicals called coagulants often alum (aluminium sulphate) to the water. This causes the small solid particles to come together in larger clusters known as flocks, which can settle faster through the water (Hofkes, 1981) The correct dose of a coagulant depends on the water being treated and may vary from day to day. The equipment for adding the chemicals should have as few moving parts as possible. And preferably not require electricity. Some turbulence is required to mix chemicals thoroughly with the water. This can be achieved by passing the water over a weir through a constriction or around baffles and no motor-driven equipment is necessary. Sedimentation can be accomplished in horizontal-flow tanks in which the water moves from one end to the other or in upward-flow tanks usually circular in which the water enters at the bottom and is taken off at the surface (Hofkes, 1981)

3.3.4 Filtration

The most commonly used method of filtration is the rapid sand filter in which water passes downwards through a sand bed about 0.45 to 1.0m thick at a rate of over 5m/hr. The water is driven through the bed either by gravity or by pressure in which case the whole filter is contained in a steel pressure vessel. The bed requires cleaning at frequent intervals usually at least once a day. This involves backwashing by forcing water or air followed by water upwards through the bed for a period of time. Various modifications

and simplifications in the control of the filtration rate of backwashing have been developed. However, because of their construction cost their complexity and their need for regular backwashing rapid sand filters are inappropriate for many applications in developing countries. They are certainly not as widely suitable as the oldest and simplest method; slow sand filtration. Slow sand filters are simple to build and operate and also improve microbiological water quality substantially a result the other types of filter cannot reliably achieve (Mairura, 2006). Slow sand filters are so called because the water moves down through them at a rate of only about 0.2 m/hr. This means that the filter beds for a large town can take up a considerable are of land but land prices in developing countries tend to be low so that this is not usually a severe constraint. Besides good land on the outskirts of a rapidly growing town is a good investment for any municipal body (Hofkes, 1981).

3.3.5 Disinfections

Slow sand filters improve the microbiological quality of water considerably but if water completely free of pathogens is required it is necessary to apply a chemical disinfectant. In practice all town water supplies require disinfections. Chlorine is the disinfectant most readily available and suitable for use in most circumstances.

3.3.6 Chlorine Demand

Chlorine is an oxidizing agent. If it is added to impure water it will immediately oxidize the impurities and no longer be available for disinfections. It is therefore essential that the chlorine dose should be greater than that required to satisfy the immediate chlorine demand of the water. This chlorine demand will vary depending on the quality of the water (Mairura, 2006). Roughly speaking 1mg/l of chlorine is required to satisfy 2mg/l of BOD (Hofkes, 1981). If an adequate dose is used to satisfy the chlorine demand a residual of chlorine remains which provides protection against contamination occurring during subsequent distribution of the water chlorine residuals are of two kinds; free and combined. (Hofkes, 1981)

3.3.7 Distribution

In many tropical cities the water distribution system is one of the biggest headaches of the municipal engineers (Hofkes, 1981). As much as 60 per cent of the water entering the system may be lost as leakage and for much of the day the water pressure may be inadequate to reach some areas at all let alone meet their potential fire-fighting needs. The problems of distribution systems are of four main types:

First, and this is an enormous problem in many tropical cities from Manila to Monrovia numerous unauthorized connections are made to the water mains by private individuals (Hofkes, 1981). This may result from high water charges from delays or corruption in the allocation of water connections or from a refusal to provide connections to squatters. The resulting erosion of the water authority's revenue makes it hard to lower the charges. The leakage from incompetent unauthorized connections diverts the authority's resources (so making it difficult to shorten the delays) and attempts to police these illegal connections frequently result in increased corruption.

Second, public water points are frequently damaged. Leaking taps wastes water and money is wasted in repeatedly repairing them. The provision of more public water points does not necessarily increase community water use but reduces the number of households using each (Hofkes, 1981). A water point serving a small group of families is more likely to be looked after and less likely to be broken by overuse or vandalism;

Third, the capacity of the system is often far exceeded by the water demand of the community. The rapid but variable growth in the urban population of most developing countries is one cause for this but not necessarily the main one. There is little evidence that this growth in population is caused by the provision of water supply but an improvement in the water supply can itself cause a significant increase in water demand (Hofkes, 1981). Some people will begin to use a community water supply when the level of provision improves having transferred from some alternative source such as a private well. Others will use many times more water while households served by standpipes will use only 15 to 30 l/person day households with a single tap in the home will typically use two three or four times as much and those with several taps will use still more;

Fourth, high rates of leakage further overburden the distribution system. Typically, 30 per cent of the water treated and pumped into the water supply of a developing country town and sometimes as much as 60 per cent is lost in this way (Hofkes, 1981). It may result from incompetent pipe lying, from exposure of mains by soil erosion from construction of houses over mains due to poor physical planning, or from sheer age of the system.

3.4 Urban Sanitation

Although the focus of this study is not Sanitation, it would be inadequate to claim to have comprehensively reviewed water supply literature without mentioning its twin cousin- sanitation. The relationship between domestic water supply and sanitation is a biotic in the sense that inadequate domestic water supply adversely affects the sanitation status of a household. Likewise, inadequate sanitation standards threaten the water resources available for supply to domestic users (Hofkes, 1981).

A major challenge facing those concerned with environmental health in developing countries is that of excreta and refuses disposal systems appropriate to high-density low-income communities. Experience has shown that most high-density, low-income communities are unable or unwilling to cover the real capital and running cost of water-borne sewerage and that city and town authorities are reluctant to subsidize urban sanitation for the poor. (Hofkes, 1981).

Water-borne systems use large volumes of drinking water merely to transport wastes along pipes – water which has to be expensively treated before being released back into the hydrological cycle. This extravagant use of water may be justified in a country with ample water resources and a well-established distribution system. Water-borne systems can be installed only in communities with individual-house water connections the majority of low-income urban dwellers do not have this facility. It is not just a question of adequacy of the distribution system, but also of the quantity of the water available. Communities with water-borne sewerage normally require more than 75 l/person day

compared with less than 20 l/person day currently used in many squatter settlements (ibidi).

Water-borne sewerage is a complex technology requiring careful and skilled construction of it is to operate smoothly. The skills necessary to design and install such a system may be in very short supply in a developing country thus forcing the employment of expatriate companies with consequent loss of foreign exchange. By and large sewers must be laid in straight lines. To dig large trenches in straight lines through squatter settlements will necessitate the demolition of a substantial number of houses, which will often be politically and socially unacceptable

By far the biggest obstacle to the adoption of water-borne sewerage for the urban poor is cost. There is yet no general agreement about the most hygienic and appropriate alternatives to water borne sewerage for the urban poor. Various systems are required to suit the diverse environments into which they are to be introduced. Research is in progress much of it sponsored by the World Bank to improve them and make them easier and cheaper to build and maintain.

3.5 Global Water Situation

More than 97 per cent of the world water is found in oceans and therefore salty and only less than 1per cent of the fresh water is available for human use. An estimated 77.2 per cent of the fresh water is trapped in the ice caps and glaciers, while 22 per cent is ground water (Kitonga, 1992). About 2/3 of this ground water lies below 750 metres of earth's surface making it exploitation prohibitively expensive. With most boreholes being only 100m to 300m, then only a small portion of the ground water is exploited for human use. Even then, water resources are the most unevenly distributed resource. The equity in accessibility to public water supply is very poor at the global level with only about 14 per cent of the World total population having access to public water supply (ditto).

The importance of water to plant, animal and human life cannot be over emphasized. Many cities and towns of profound economic, cultural and religious importance were and still are built near water sources. In deed, several global economies were built on the strength of water transportation (The East African Standard, March 22, 2006). The

hydrological cycle is part of the ecosystem that sustains life. Save drinking water contributes to survival, health and economic development of a nation, however, global resources are increasingly under threat from pollution and degradation of catchments areas.

The Millennium Development Goals (MDGs) as agreed by the UN member states at the Millennium Summit in 2000, did set specific targets for reducing poverty, hunger, disease, illiteracy, environmental degradation and discrimination of women by 2015. Among these targets the National Governments agreed to reduce by half the proportion of people without access to safe drinking water by 2015, the year to mark the end of the International Decade for action, 'water for life '. The millennium declaration emphasized the need for all countries to stop the unsustainable exploitation of water resources. At the Johannesburg Summit, Africa National Governments agreed to develop integrated water resource management and water efficiency plans by the year 2005 (Development Trust Fund, 2005).

Worldwide population growth, increased food production higher industrialisation levels and consumptive lifestyles are creating a higher demand on the planets sources of fresh water (The East African Standard, March 22, 2006). To ensure a continuous global water source, that will meet future demands, there is need for improved water conservation, collection, storage and treatment, transmission and distribution methods. Though several strategies exist for sustainable water resource development, experts agree that water conservation; sensible domestic uses as well as conservation of catchments are vital. The cornerstone of any domestic water supply initiative is conservation. User education and awareness play a key role in water conservation measures as a lot of water is wasted especially in urban areas.

3.6 Water Situation in Africa

In Africa regions, just like Asia and South America, improving efficiency in use of household and municipal water is necessary, but increased supply of water for drinking is even more urgent. It could be for this reason that 1980 – 1990 International Water Drinking and Sanitation Decade efforts were directed to supplying water in urban areas. According to Kalbermalten, 1980 only 15 per cent of Africa's total water resources was exploited and only about 5 per cent of Africa urban population were receiving safe

drinking water. Kalbermalten further observed that in order to serve the ever-increasing population, there is an urgent need to intensify the exploitation of water in the world. This measure could not have been less urgent in Africa.

3.7 Water Situation in Kenya

Kenya receives about 360 billion cubic metres of rainwater of which a good portion could be harvested, stored and distributed for use for domestic, industrial and irrigation purposes. (The East African Standard, March 22, 2006). Despite this rather favourable situation, the national coverage of safe drinking water is estimated at only 40 per cent (ditto). According to nation-wide water resources assessment study carried out under the National Water Master Plan in 1992, it became clear that the surface and groundwater resources are unevenly distributed both in space and time (Kenya, 1999).

Increased human activities, particularly in the water catchments areas has reduced and deteriorated areas under forest thus threatening the water resource in respect of siltation, surface runoff, water balance and groundwater characteristics. This complicates further the water availability problem. The basic solution to those problems lies, as it has been suggested in the official policy documents in the conservation, preservation and development of national water resources in the most feasible manner currently, Kenya has 3,000 small pans and dams with a total storage of approximately 124 million cubic metres. If Kenya was to achieve the margins of halving the number of people without access to safe drinking water by soils, about 30 times the current capacity will be required based on catchments conditions existing in 1980 (East African Standard, World Water Day Supplement, March 26, 2006) Given that massive degradation has occurred since 1980, a lot of more water storage and massive development of infrastructure and technology will be required to melt the required demand.

3.8 Meeting the Millennium Development Goals Targets in Water and Sanitation

The combination of save drinking water and hygienic sanitation facilities is precondition of health and success in the fight against poverty, hunger, child deaths and gender equality. It is also central to human rights and personal dignity the human race. Yet, 2.6 billion People half the developing world lacks even a simple 'improved' latrine. In

adopting the MDGs the countries of the world pledged to reduce by half the proportion of people without access to safe drinking water and basic sanitation. The results so far are mixed with exception of sub-Saharan Africa (World Bank, 2002).

It is important to note here that provision of safe domestic water in general contributes in one way or another towards meeting the other MDGs goals.

The eight MDGs are:

1. Eradicating extreme poverty and hunger,
2. Achieve universal primary education,
3. Promote gender equality and empower women,
4. Reduce child mortality,
5. Improve maternal health,
6. Combat HIV/AIDS Malaria and other disease, and

Ensure environmental sustainability; develop a global partnership for development. (World Bank, 2002)

3.9 The Challenge of Building Partnership in Water Development

In the last fifty years, the world's urban population has increased fourfold, and now close to 50 per cent of the world's population lives in urban centres. But while the urban population grew rapidly, expansion of water supply and sanitation services did not keep pace with growth. As a result it is estimated that between 30 per cent and 60 per cent of the urban population in most nations is not adequately served (Brocklehurst, 2004). Factors that influence access are numerous. Financial and economic factors relate to connection charges and tariffs, technological issue include standards that are often challenging to introduce in poor urban communities, political barriers include the lack of priority that is placed on services; and institutional factors relate to the question of who makes decisions, who co-ordinates action, and who implements projects. Local authorities are unlikely or unable to help poor urban dwellers – they may be constrained by lack of resources, technical limitations, or the fact that many urban settlements in which the poor reside are informal or even illegal.

Existing technical and financial approaches have proven time and again to be insufficient to meeting the challenges of providing sustainable water services, especially among the

urban communities. Hence, multi-sector partnership between relevant stakeholders – by they from public, private, civil society and donors' spheres – provide one tool to overcome these failures. Such partnership promotes innovation and greater accountability whilst improving the understanding and capacity that make water projects more appropriate and effective (Brocklehurst, 2004).

3.10 The Genesis of Water Sector Reforms

The challenge of managing national water resources and maximizing the availability of potable water to the majority of Kenyans has tasked successive governments since Independence .In the early seventies; an ambitious water master plan was launched to ensure availability of water to all households. But the approach of taking over water supplies previously managed by communities, local authorities and public institutions were found to be unsustainable since the Government lacked the resources to directly enhance or subsidize these services (Ministry of Water Resources, 1999). By the eighties it was clear that the government could not, on its own, deliver water to all Kenyans .The focus then shifted to 'handing over '– a process of finding ways of involving others in the provision of water services in place of the government. Through this process, provision of basic services – including water and sanitation, education and health – could be achieved by involving beneficiaries through cost sharing. However, only piecemeal reforms were achieved in handing over of ownership and management of water supplies to communities. Despite ambitious water supply development programs, only one of every three Kenyans could access potable water by the turn of the millennium. The impetus for policy reforms was largely influenced by the acceptance that good governance was critical for economic growth.

Water resources contribute enormously to economic productivity and he social well being of the population. However, the provision of adequate and reliable water supply is essential for the realization of sustainable social and economic development. The demand for water has increased tremendously with increased population growth and the attendant social economic pursuits such as urbanization, industrialization and agricultural activities.

'The country's Poverty Reduction Strategy Paper (PRSP) and the Economic Recovery Strategy for Wealth and Employment Creation (ERS) call for implementation of structural reforms to make water and sewerage services autonomous, efficient and effective. To achieve this, it is critical to mobilize investment for construction and rehabilitation and enhance partnerships with communities to expand services to the urban poor and rural communities'-Minister for Water and Irrigation.
Though safe drinking water and sanitation contribute to survival, health and economic development, Kenya's water and sanitation situation is characterized by inadequate access to safe and reliable water and basic sanitation for over half of the population (Ministry of Water and Irrigation, 2005).

Studies and surveys indicate that the country's water resources are also under increasing threat from pollution, degradation of catchments and over exploitation. Development of the water sector has been constrained by among other factors: Water scarcity due to uneven distribution of the water resources and variability of rainfall patterns, institutional weaknesses and weak coordination among institutions in the sector, and inadequate funds for development and management of water resources, water and sanitation services. Thus the reforms are intended to address such weakness by promoting integrated management water resources and development of water and sanitation services. The reform agenda also emphasizes greater community involvement for sustainability (Water Sector Reform Secretariat- Ministry of Water and Irrigation, 2005).

3.10.1 The National Water Policy and the Reforms

In recognition of the role of water in national development, the Government has over the years initiated policies and strategies to improve water access. Instrumental among these is the National Policy on Water Resources Management and Development published as Sessional Paper No. 1 of 1999 (Kenya, 1999). This policy aims at attaining sustainable development and management of the water sector.

3.10.2 The New Policy

The new water policy addresses water resources management, water and sewerage services delivery, institutional arrangements and financing. The role of the Government

is redefined to focus on regulatory and enabling functions, rather than direct service provision. The policy paper argues that in a liberalized socio-economic framework, it is unwise to continue spending public funds on utilities whose operational costs could not be sustained. Instead, the Government places emphasis on supporting private sector participation and community management of services. Communities are also to be involved in all stages of water projects development, including water resources investigations, planning, implementation and operation and maintenance (Ministry of Water and Irrigation, 2005).

The Kenya's water sector reforms are structured very closely along the lines that Zambia took as early as 19994. Increasingly aware of the constant degradation of WSS, as well as the growing weakness of water resources management, the Zambian Government embarked on an ambitious sector reforms with the adoption of a new water policy in 1994 The policy included seven sector principles, which guided the reform process to date (Development Trust Fund, 2005). Milestones of water reforms so far include the enactment of the Water Supply and Sanitation Act, 1997, Establishment of 10 Commercial Utilities (CUs), an Urban WSS sector regulator, National Water Supply and Sanitation Council (NWASCO) and the Devolution Trust Fund (DTF). For the last 10 years, good progress has been made largely because of adhering to the set out principles. These principles shaped the new institutional framework that guides the reforms implementation. Just like Kenya's They include separation of WRM and WSS; Decentralisation of WSS by devolving WSS functions to Local Authorities; separation of policy making and service provision; opting for commercialisation of service provision by encouraging LAs to form CUs (Shareholder companies) large enough to generate the benefits of economies of scale. Presently more than 90 per cent of the urban and peri-urban population live in the service areas of one of the 10 CUs; separating policy from regulation lead to the establishment of an autonomous regulator (NWASCO) in 2000. Commercialisation and regulation helped to stop the decades long degradation of WSS systems and to improve service provision in most of the towns (Development Trust Fund, 2005) .

3.10.3 The Legal Framework

The Water Act of 2002 lays the legal framework for implementing the current water policy. Its main thrust is the separation of the functions of water supply and sewerage from those of managing water resources, and also policy formulation from sector regulation. In whole, the reform process embraces the principles of commercialisation and private sector participation as powerful responses to problems of water delivery services in urban and peri-urban areas.

3.10.3.1 The Water Act 2002

The Water Act 2002 that effectively replaced the Water Act CAP 372 in March 2003 provides the legal framework for the implementation of the provisions of the Sessional Paper No. 1 of 1999. The provisions of the Act allow for the necessary reforms: management of water resources, strengthening the institutional framework of the sector while eliminating he ole of the government in the direct service provision and providing mechanisms for financing water resources management and water and sanitation services provision.

3.10.3.1.1 Institutional Arrangements of the Water Act 2002

The Act introduces new features in the management of water resources and sewerage services. The main essential features of the Act are: Separation of water resources management from water and sewerage services, establishment of autonomous regulation in the sector, decentralization of services to the regional level, focusing the role of the ministry to policy formulation, sector coordination and financing, and the establishment of Water Services Trust Fund. Table 2-2 summarises the framework for the implementation of the new institutional arrangements.

Table 3-2 Responsibilities of Institutions Established Under The Water Act 2002.

Institution	Responsibilities
Water Resources Management Authority (WRMA)	Implementation of policies and strategies relating to management of water resources. Water allocation; source protection and conservation, water quality management and pollution control.
Water Services Regulatory Board (WSRB)	Overseeing the implementation of policies and strategies relating to provision of water services; regulating the provision of water supply and sewerage services; licensing WSBs and approving their appointed WSPs, monitoring the performance of WSBs and WSPs for quality assurance.
Water Services Board (WSBs)	Planning for improvement in provision of water supply and sewerage services, appointment and contracting WSPs; Asset holder of central government facilities.
Water Services Trust Fund (WSTF)	Assisting in the financing of provision of water supplies in areas that are inadequately provided for.
Water Appeals Board (WAB)	Adjudicating disputes between sector players.

Source: Kenya (2005) Kenya Gazette Supplement No. 61, Nairobi, Government Printer.

Provision of water services shall only be undertaken under the authority of a licence issued by the regulatory board to water services board, which in turn, shall contract a water service provider to provide services to consumers. Provision of water services shall involve two national Institutions, the regulatory board and the water services trust fund; supported by the seven regional water services Boards namely; Coast Water Services Board, Athi Water Services Board, Tana Water Services Board, Rift Valley Water Services Board, Lake Victoria North Water Services Board, Lake Victoria South Water Services Board. The Athi Water Services Board (AWSB) covers the following districts, Nairobi, Thika, Kiambu, Kajiando, Makueni and Machakos (Kenya, 2005).

The subject of transfer as contained in the subsidiary legislation includes the transfer by the Ministry of overall administrative and legal responsibility for the provision of water

services to the Water Services Boards and this includes ensuring of efficient and economical provision of services, planning development of services and facilities, to progressively increase access to water and sewerage services, among others. Section I.B.3 provides for a framework through which a WSB can enter into suitable arrangements with local authorities for accessing facilities owned or used by local government service providers (Kenya, 2005).

The framework encompasses recognition of partnerships between a local authority and the Water Service Board in the provision of water supply and sewerage services; creation by local authorities, of autonomous legal entities for provision of water supply and sewerage services. The framework shall be flexible to suit different circumstances including recognition of the role played by community, self-help groups, CBOs and NGOs in the provision of water supply and sanitation services, engagement of these non-governmental initiatives into the development plants of the WSP, etc.

3.10.4 Decentralisation

Authority over the water sector has now been decentralized to players that is operating different levels, from the Ministry in charge of water affairs right down to the consumer (KISIMA, 2005). Executive authority is also devolved to new institutions: water supply and sewerage to the Water Services Regulatory Board (WSRB) and water resources to the Water Resources Management Authority (WRMA). The Act further provides for regulation of water provision services, which can only be undertaken under the authority of a license to service providers. At the national level, the Government is responsible for strategic planning and inter-sectoral coordination, including collaboration efforts with development agencies, civil society and the private sector. This portfolio is under the Ministry of Water and Irrigation.

The WSRB is responsible for regulating of water and sewerage services provision, including issuing licenses, setting service standards and guidelines for tariffs and prices, and providing mechanisms for handling complaints. Responsibility for provision of water services is vested in Water Service Boards (WSBs), under the regulation of the WSRB. Seven Water Service Boards have so far been established across Kenya to

manage provision of water services in Nairobi, Coast, Central, Lake Victoria, Rift Valley, North and Lake Victoria North regions. But direct provision of water services is to be undertaken by Water Services Providers (WSPs) that operate as licensees of the water service boards. These service providers may be community groups, on-governmental institutions or autonomous entities formed by local authorities (KISIMA, 2005).

However, the immediate challenge facing the government is to complete the transfer of management and operation of water services to these WSBs. (KISIMA, 2005). To assist in financing the provision to areas without adequate water services, a Water Services Trust Fund has been set up to tap funding potential from the government, donations or grants. Regulation of the sector is checked by a Water Appeals Board, a tribunal of appeal on disputes within the sector. However, the immediate challenge facing the government is to complete the transfer of management and operation of water services to these WSBs. With an expanded field of water managers, the challenge facing the reforms process is how the institutions are financed and run; their acceptability to various stakeholders; and how to respond to mounting pressure for increased private sector and community participation in direct services provision. (KISIMA, 2005).

3.11 Conceptual Framework

Inadequate or lack of water supply in urban and peri-urban areas creates bottlenecks to sustainable development. The main challenges to inadequate urban water supply include: expansion of human settlements to new areas previously under agricultural; lack of high quality water sources; contamination of groundwater sources; difficulties in financing major water infrastructures facilities (Turton, 1999).

Conflict among competing water users and sectors contribute to increased poverty and declining economic performance. In addition inadequate financial resources, mismanagement of water resources, and weak regulatory mechanisms has resulted to degradation of environment and declining socio-economic fortunes in both rural and urban areas. In this regard planning for effective water supply and better sanitation is key to providing basic services. There is evidence that good governance is a fundamental requirement for development and poverty reduction and in this connection water

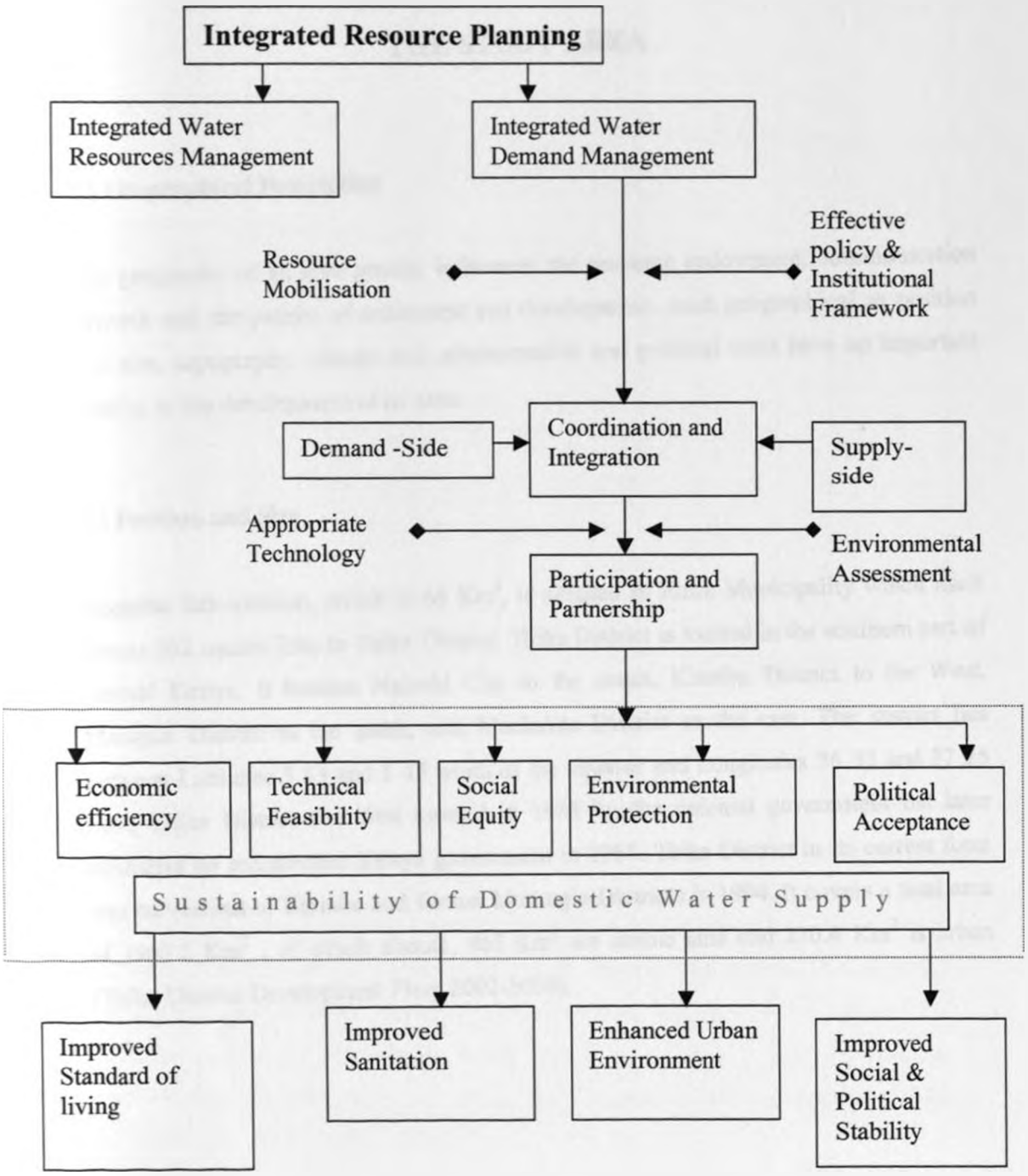
management and provision must be looked at from an integrated perspective for sustainability (Turton, 1999).

To balance the demand and supply of water in urban and peri-urban areas, a number of proposals have been suggested in the past. These suggestions include: checking population growth; adoption and use of appropriate technology; regular review of water and water related policies; mobilization of resources for sustainability and the incorporation of environmental assessment in all development activities that affect water resources (Ben, undated). The management of water resources and services was, and for most part continues to be based in the separate sectoral administration of the different uses of the resource. The fragmentation means that there has been no means of moderating between competing and high-value and low-value demands (Global Water Partnership, 2003). An integrated approach allows competing claims to be moderated by well-informed and participatory political processes economic mechanisms (Global Water Partnership, 2003). Analysis based on Integrated Resource Planning (IRP) framework can allow equity considerations to be given a higher level of attention than has been the case before. IRP is result oriented unlike the traditional planning practice, which focuses on the best-perceived solution of an institution perspective.

Figure 3-1 refers to the conceptual framework that guides the study and which indicates the various components that contribute to integrated resource planning in the perspective of this study. The IRP perspective adopted in the study combines Integrated Water resource Management (IWRM) and Integrated Water Demand Management (IWDM) but with an obvious bias towards IWDM. Sustainable water resource planning call for a careful balance between the supply-side and demand–side of the water equation. The management of urban water demand if approached in an integrated manner results in better coordination and integration of policies and resources. This favourable situation facilitates public participation and partnership for sustainability of urban domestic water supply. However, for sustainability of domestic water supply to be realised, the factors that induced bottlenecks in the sectoral traditional approach must be addressed adequately. Thus, such mitigating measures as adequate resource mobilisation use of appropriate technology, and a mandatory environmental impact assessment for all major or unique urban water supplies must be put in place. The IRP demand that an effective policy and institutional framework is put in place to promote efficiency, harmony and

governance in water delivery systems in urban and peri-urban areas. As figure 3-1 show, an effective IRP mechanism would result to enhanced social equity and economic efficiency among other direct benefits. Ultimately, the urban population would enjoy better standard of living in an improved urban environment.

Figure 3-1 The Conceptual Framework



CHAPTER FOUR

THE STUDY AREA

4.1 Geographical Description

The geography of an area greatly influences the resource endowment, communication network and the pattern of settlement and development. Such geographical as position and size, topography, climate and administrative and political units have an important bearing to the development of an area.

4.2 Position and Size

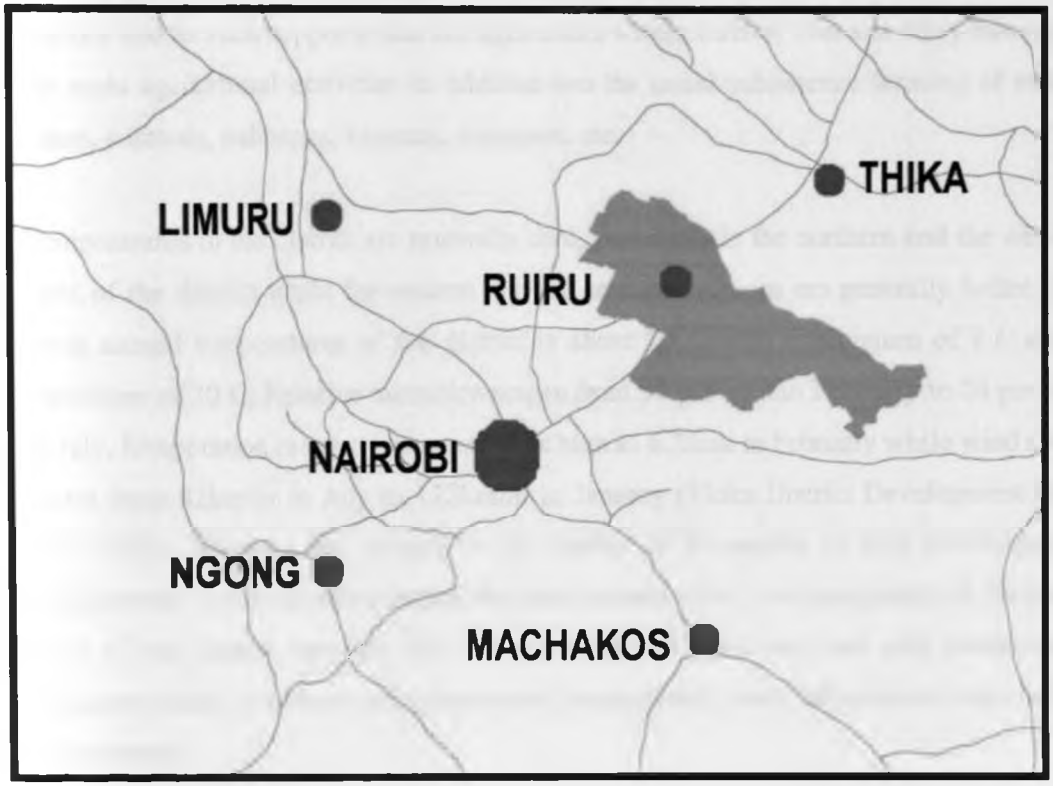
Mugutha Sub-location, which is 66 Km^2, is situated in Ruiru Municipality which itself covers 292 square Kms in Thika District. Thika District is located in the southern part of Central Kenya. It borders Nairobi City to the south, Kiambu District to the West, Maragua District to the north, and Machakos District to the east. The district lies between Latitudes 3 53 and 1 45 south of the equator and Longitudes 36 35 and 37 25 East. Thika District was first created in 1953 by the colonial government but later abolished by independent Kenya government in 1968. Thika District in its current form was curved out of Kiambu and former Murang'a Districts in 1994. It covers a total area of 1960.2 Km^2 , of which about1, 465 Km^2 are arable land and 270.4 Km^2 is urban (Thika District Development Plan, 2002-2008).

Figure 4-1 Thika District in National Context

Source: Survey of Kenya, 2002

The proximity of Thika District to Nairobi has had a profound impact on the industrial development in the district, especially at Ruiru and Thika Urban centres. This is mainly due to accessibility to other industrial operations and activities, a well-established communication network, accessibility to raw materials, availability of ready markets, abundant human resources, and closeness to main sources of electrical power (Thika District Development Plan 1997- 2001).

Figure 4-2 Ruiru Municipality in the Regional Context



Source: Survey of Kenya, 2002

4.3 Physiographic and Natural Conditions

Thika District has a diverse topography, Altitudes ranges from 1060 to 3550m above the sea level. The highlands form the water catchments area and watershed of most of the rivers, which drain to the lowland. The higher areas of Gatundu and Gatanga to the west have deeply dissected topography and are drained by several rivers all flowing from Aberdare's Ranges to the west and flow towards the South east to river Tana. The lowland areas in the eastern parts of the district are generally semi arid and receive low and erratic rainfall. These cover Kakuzi, Thika municipality, and Ruiru Divisions. The flat topography, the low rainfall and the well-drained soils make the area suitable for beef cattle rearing and irrigation agriculture, mainly for coffee and Pineapple production. Floriculture activities and growing of other types of citrus fruits for both local and export market are also finding an increasing place in the lower parts of the district.

Annual rainfall in the district ranges between 500mm to 2500mm. The northern and the western parts of the district enjoys substantial amounts of rainfall that falls in two rainy seasons and as such supports rain fed agriculture where Coffee, Tea, and dairy farming is the main agricultural activities in addition ton the usual subsistence farming of maize, beans, potatoes, cabbages, bananas, tomatoes, etc.

Temperatures in the district are normally cool, especially in the northern and the western parts of the district while the eastern and the southern regions are generally hotter. The mean annual temperatures of the district is about 20 C with a minimum of 8 C and a maximum of 30 C. Relative humidity ranges from 57 per cent in February to 74 per cent in July, Evaporation rate may increase to as high as 6.3mm in February while wind speed varies from 42km/hr in July to 122km/hr in January (Thika District Development Plan, 2002-2008). Whereas the climate of the district is favourable to crop production, it inhibits road communication during the rainy season. Also, the topography of the upper parts of the district coupled with high rainfall and poor land and soil conservation practices results to serious soil erosion and subsequently heavy siltation of water bodies downstream.

The lower parts of Ruiru receive low annual rainfall ranging from 116mm to 965mm and as such it is a perpetual beneficiary of relief food during the dry periods. This is despite the numerous rivers that traverse the area.
The number of people with access to protected springs is about 5,650 while that with roof catchments is 18,000 in the district. The average distance to nearest potable water point is about ½ Km.

According to a District wide water resources inventory survey done by the district water engineer's office recently, there are seven government water schemes in the Thika District; one municipal water supply scheme; a number of institutional water scheme, corporate water schemes, community based water projects and Central Kenya Dry Area Programme (CKDAP) water users groups (15). Among these Programmes, projects and schemes, Ruiru and Juja water supplies, Ruiru prison staff college water supply and Ruiru GSU water scheme, Plains View Hospital, Ruiru high School, Mugutha and Watalamu community water projects are found in Ruiru Municipality among other upcoming ones.

Thika District has a high potential for underground water (Thika District Development Plan 2002-2008). This is evidenced by the many boreholes scattered in ruiru Division as observed in the current District Development Plan. However, with the exception of Ndakaini Dam, which is the main source of water for Nairobi city for, the district does not have significant surface water mass.

4.3 Administrative and Political Units

Thika District is divided into six administrative divisions, four political constituencies and three local authorities as shown in table 4-1, 4-2 and figure 4-3 below.

4.3.1 Administrative Units

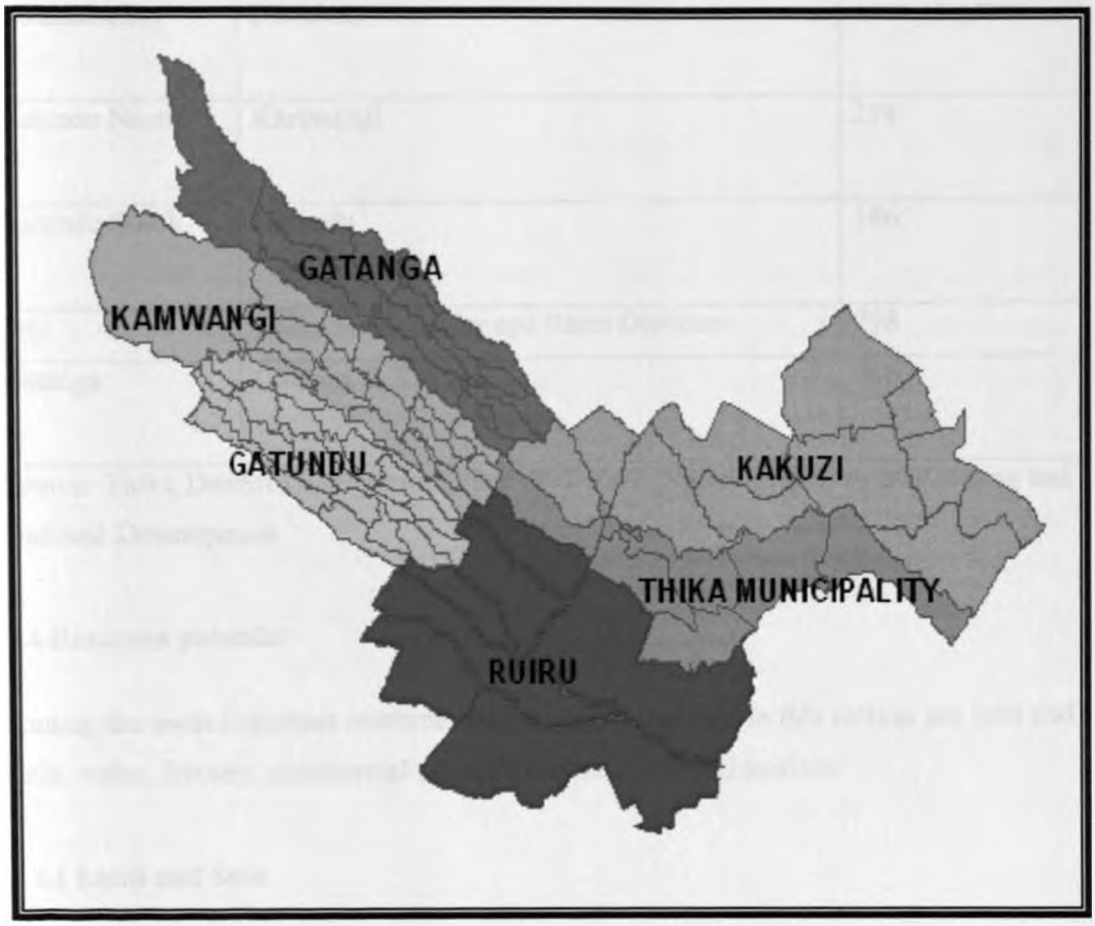
Administratively, Thika district is made up of six divisions, namely Thika municipality, Gatanga, Kakuzi, Ruiru, Gatundu, and Kamwangi of which Ruiru division is the largest (526.6 km^2) and Gatundu division is the smallest (192 km^2). Ruiru division is made up of Ruiru and Juja locations.

Table 4-1 Administrative Units

Division	Area (Sq. km)	Locations	Sub-locations
Thika municipality	220.2	2	7
Gatanga	251.1	4	17
Kakuzi	481.2	4	12
Ruiru	526.6	2	7
Gatundu	192.1	4	23
Kamwangi	289.0	4	23
Total	**1960.2**	**20**	**89**

Source: Thika District Development Plan 2002-2008, Nairobi, Ministry of Planning and National Development

Figure 4-3 Administrative Units in Thika District



Source: Thika District Development Plan 2002-2008, Nairobi, Ministry of Planning and National Development

4.3.2 Political Units

There are three local authorities in Thika district namely Thika County Council, Thika Municipal Council and Ruiru Municipal Council. Thika County has 18 civic wards, Thika Municipality has 12 and Ruiru Municipality has 6, making a total of 36 civic wards. Politically, Thika District has four constituencies namely: Gatundu South, Gatundu North, Gatanga, and Juja. It is important to note here that the political and administrative units do not necessarily correspond, making provision of some services cumbersome.

Table 4-3 Political Units

Constituency	Divisions	Area (Sq.km)
Gatundu North	Kamwangi	294
Gatundu South	Gatundu	186
Juja	Thika Municipality and Ruiru Division	798
Gatanga	Gatanga & Kakuzi	746

Source: Thika District Development Plan 1997-2001, Nairobi, Ministry of Planning and National Development

4.4 Resource potential

Among the most important resources of the district outlined in this section are land and soils, water, forestry, commercial minerals and materials and tourism.

4.4.1 Land and Soils

Wide variation in altitude, rainfall and temperature between the highland and lowland areas, combined with differences in the underlying geology, give rise to a variety of soil types in the district. This variation in turn determines the distribution of the flora, agricultural activities and of the agro-ecological zones in the region.

Volcanic rocks are found in the western parts bordering the Aberdares, while rocks of the basement system occur in the eastern part. Soils derived from volcanic activity are generally fertile and suitable for agriculture. Rich volcanic soils are found in the higher altitudes and are particularly suitable for tea growing.

4.4.2 The Main Agro-Ecological Zones in Thika District

The Upper Highland Zone (UH): This zone is suitable for sheep, dairy cattle and vegetable growing. It covers mainly Gatundu and Gatanga Divisions. This zone has

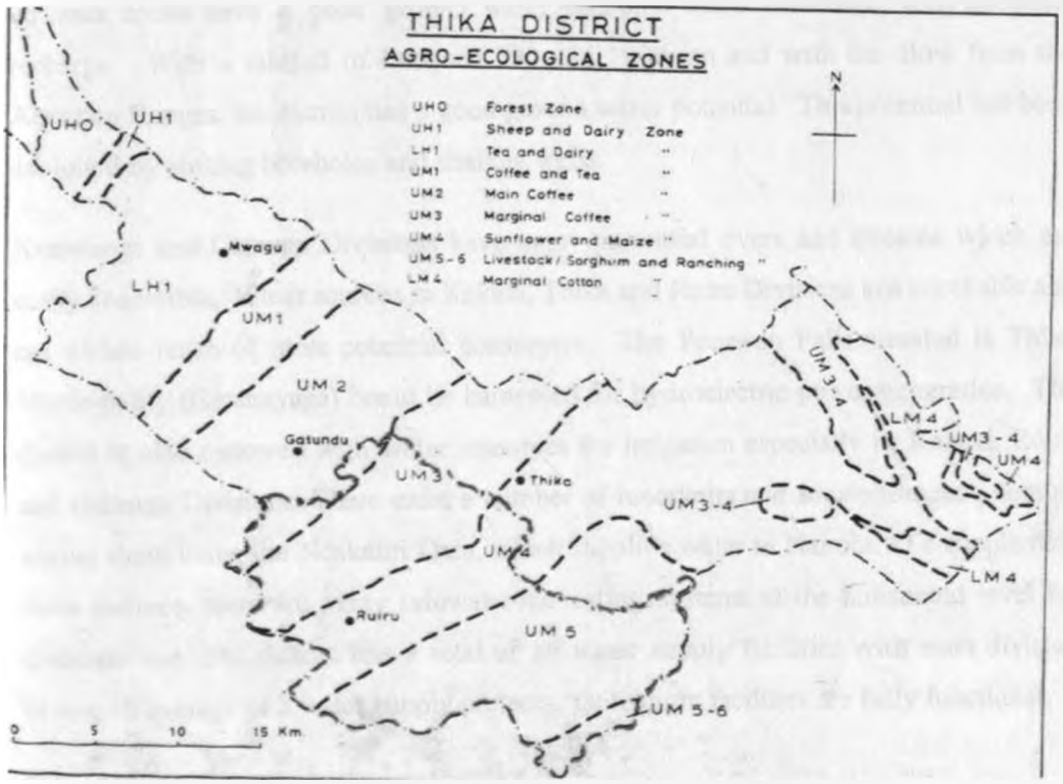
high fertility soils to moderate fertility soils. It also receives higher rainfall than the other parts of the district. Other crops, which do well in this zone, are tea, coffee, maize, beans, bananas and horticultural crops.

1. Upper Midland Zone (UM_1): This zone is suitable for coffee and tea growing. It is also found in Gatundu and Gatanga.

2. Lower Midland Zone (LM_4): In the lower mid-land zone cattle and sheep are reared. This is the lower part of the district mainly in Kakuzi Division. This area has low fertility soils and has low and poorly distributed rainfall. Other crops grown are barley and drought resistant crops.

3. Upper Midland Zone (UM_{3-4}): This zone is mainly in Thika and Kakuzi Divisions. It has moderate to low fertility soils and is suitable for maize, sisal, beans, potatoes, cotton, tobacco, sorghum, and sunflower ad marginal coffee.

Figure 4-4 The Main Agro-Ecological Zones in Thika District



Source: Adapted from Thika District Development Plan 1997-2001, Nairobi, Ministry of Planning and National Development

4.4.3 Water and Water Facilities

The district has both surface and ground water resources. The major rivers are Chania, Ndarugu, Nairobi, Athi, Thiririka and Theta. They all drain into the Athi drainage basin. There is also Thika River that drains into the Tana drainage basin. These rivers originate mainly from the Aberdare Ranges and as they pass through intensely cultivated farmlands and plantations they become polluted with agricultural pollutants such as pesticides, fertilizers and coffee wastes, thus necessitating water treatment. Soil erosion also introduces suspended matter and colloids leading to further pollution of the water. According to Poverty Reduction Strategy Paper for the period 2001-2004 the main water sub sector issues were inadequate drinking water; lack of rehabilitation of water supplies and low funding of water projects.

Availability of ground water depends mainly on the type and nature of rocks underlying a particular area. In Thika District, more than 95 percent of the rock out-crop is volcanic, underlain by the Kapiti Phenolate, below which lies the basement system. The volcanic rocks have a good ground water capacity when associated with adequate recharge. With a rainfall of between 500 and 1800mm and with the flow from the Aberdare Ranges, the district has a good ground water potential. This potential has been exploited by sinking boreholes and shallow wells.

Kamwangi and Gatanga Divisions have many perennial rivers and streams which are easily accessible. Water sources in Kakuzi, Thika and Ruiru Divisions are unreliable and not within reach of most potential consumers. The Fourteen Falls situated in Thika Municipality (Gatuanyaga) could be harnessed for hydroelectric power generation. The district is also endowed with water resources for irrigation especially in Kakuzi, Ruiru and Gatanga Divisions. There exist a number of reservoirs and impoundments, notable among them being the Ndakaini Dam, which supplies water to Nairobi. To supplement these sources, there are many rainwater-harvesting systems at the household level for domestic use. The district has a total of 16 water supply facilities with each division having an average of 3 water supply projects. Only eight facilities are fully functional.

Table 4-3 Production and Estimated Demand of the Major Water Supplies in Thika District

Water Supply Scheme	Production Capacity (m^3/day)	Actual Yield (m^3/day)	Estimated demand (m^3/day)
Thiririka	10,572	7,400	10,000
Ndarugu	7,430	5,200	7,000
Karimenu	4,430	3,100	6,000
Ruiru	1,000	7,00	3,000
Ithanga	720	500	2,500

Source: Thika District Development Plan 1997-2001, Nairobi, Ministry of Planning and National Development

The supply of water from the facilities indicated in the table does not meet the demand of the communities who rely on them. The demand of water is especially high around Karimenu, Ruiru and Ithanga, where water supply is far below the demand. Although Thiririka and Ndarugu water supplies produce a lot of water, which almost meets the estimated domestic demand, these facilities need further augmentation, as they are inadequate to support domestic, livestock and industrial use in the district. Most notable, is the Ruiru Water Supply, which is an urban water supply. It supplies water mainly to Ruiru Town and the surrounding areas.

The supply in Ruiru Town was originally designed for a small population but the population and number of industries have been increasing in recent years. Juja farm was a former large-scale plantation area, which has now been sub-divided, and people have started settling there over the recent years. The area thus lack sufficient water supply for domestic use. Kakuzi Division also lacks adequate water supply despite being served by Ithanga Water Supply. The government and NGOs (especially World Vision) are involved in development of community water supplies for domestic and livestock use in Kakuzi Division (Kenya, 1997).

Due to many factories in Thika and Ruiru Towns, there have been cases of water pollution. Rivers Ruiru, Thika and Ndarugu have had instances of pollution from industrial activities. In other parts of the district water pollution is mainly from coffee factories. However, relevant authorities such as the District Environment and Management Committee are pursuing remedial measures (Kenya, 2002b).

4.4.4 Forestry

The total forest area in Thika District is 22,291.1 hectares. Of this, 5708.1 hectares comprise plantations and 16.521 hectares is natural forest. The gazetted forest in the district makes upto 97 per cent of total forest area and the rest is ungazetted. The two major gazetted forests are Kimakia and Kieni Forests. Kimakia Forest has 5,591 hectares of natural forest and 2,000.1 hectares of plantations. Kieni Forest has 10,081.6 hectares of natural forest and 3,708 hectares of plantations (Kenya, 1997).

4.4.5 Commercial Minerals and Materials

The only mineral resources of economic significance in the district are natural stone and clay, which are important in the construction industry, since they provide building stones, ballast and bricks. Stones are found in all the six divisions of the district.

4.5 Local Economy

Once a large scale agricultural (Coffee and Sisal farming) and livestock keeping area in 1960s and early 1970s, the region has undergone tremendous land use and environmental changes over time. The driving forces to these challenges have been the emergence of land buying companies and cooperatives in the mid 1970s. Such entities include Githunguri and Nyakiyua land buying companies. By mid 1980s most of the land was subdivided to the shareholders setting pace for human settlement and attendant human activities thereon. Around the same time Ruiru town was industrializing rapidly and by mid 1990s, the town was a beehive of industrial and booming economic and social activities. The municipality was fast urbanizing due to migrations in search of better living conditions offered by the growing economy of the town. Availability of cheap land that offered opportunity to continued agricultural lifestyles of the initial immigrants was an incentive to rapid settlement. By early 2000s the municipality area was a

settlement area of over 100,000 people. This rapid population growth and the sparse settlement pattern that resulted due to expansive nature of the municipality made the provision of water and other services difficulty (Kenya, 2002b).

4.5.1 Agricultural Activities

Because most parts of Thika District have favourable climatic conditions and fertile soils, which support various agricultural activities, agriculture is a major activity in the district. The major crops grown in the district include maize; beans, Irish potatoes and sweet potatoes while the major cash crops include coffee, tea, pineapples, macadamia and flowers. Thika District is divided into 243,636 small farm holdings, which are owned by 81,212 farm families. Most of the inhabitants are small-scale farmers who are engaged in production of various cash crops and subsistence crops. It is important to note, however, that some farm families own more than one farm holding (Kenya, 2002b).

4.5.2 Tourist Attractions

The district has a few tourist attractions. Ndakaini Dam, which supplies water to residents of Nairobi under the Third Nairobi Water Project, is a major tourist attraction. The dam is large and has potential for tourist development activities such as water sports, boating, fishing, provision of catering services in restaurants and hotels. The Fourteen Falls is an important site for tourist attraction due to the waterfalls and the neighbouring Ol Donyo Sabuk (Machakos District). The Chania and Thika Falls, which are situated near Blue Post Hotel, are very popular spots. Visitors from various visit these falls. Blue Post Hotel is a popular stop over among tourists travelling to other tourist destinations like Mt. Kenya, Nanyuki and the Aberdares (Kenya, 2002b).

4.6 Demography and Settlement Patterns

The demographic profile of a planning unit such as a district is an important variable in the development process. The settlement patterns are mainly determined by climatic conditions among other factors such as availability and cost of land, transportation and communication infrastructure. The settlement pattern affects the ease and cost effectiveness of service provision. Water, sanitation and other infrastructure services are

particularly expensive to provide where the pattern of human settlement is sparse as is the case is in the drier parts of the district.

4.6.1 Population

Going by the 1989 Census, it was possible to compute the population of Thika District as 489,306 people in1989. Growing at a rate of 2.9 per cent then, it was projected to rise to 653,902 in 1999 and 692,946 in the year 2001. However, the 1999 Census puts the district's population at 645,713 in 1999. The current District Development Plan 2002-2008 projected a population of 701,664 by the year 2002. The District's population growth rate is 2.8 per cent as of 1999.

Due to rapid population growth in the district, there has been an increasing imbalance between supply and demand for basic facilities and services in such sectors as education, health, and water. Infrastructure facilities have also been constrained as the demand for infrastructure and services rises. Also affected by high population growth is Land and other natural resources including water. The ever-increasing pressure on land has led to rapid subdivision in both rural and urban areas. Unplanned land subdivisions in the district in response to this land pressure posses a significant challenge to development planners in the district in general and urban areas in particular.

4.6.2 Distribution and Density

In the overall, Thika district is densely populated with a population density of 242 persons per sq.km in 1989, 329 persons in 1999 and projected to 358 in 2002. The population of the district is not evenly distributed with more concentration in urban centres and western and northern rural areas of Gatundu (643 in 1999), Kamwangi and Gatanga (Kenya, 2002b).

The population of Ruiru division was 73,574 in 1989 and grew to 150,710 in1999 according to the 1999 Census. The population density in 1989 was 140 but increased to 286 in 1999. The projected population of the division is 163,769 by the year 2002. Although the population density of Thika District in general is high, the lower parts of the district such as Juja, Kakuzi (162 in 1999), and Gatuanyaga are sparsely populated.

The same can be said of the lower parts of Ruiru- 'Murera Sisal'. Figure 4-4 shows the population distribution in Ruiru division. It is evident from this figure that Mugutha sub-location is not densely populated as yet while Theta sub-location is the least populated as it contains a very small resident population.

High population density has put pressure on land often leading to its subdivision into small uneconomical units leading to increased poverty, especially in the Arid and Semi Arid Land (ASAL) areas of the district. This includes parts of Ruiru municipality. Pockets of poverty are found in urban slums mainly within Thika municipality, Juja and Ruiru. This undesirable situation is also replicated among the casual workers in large-scale plantations in Ruiru and Kakuzi Divisions. In Ruiru municipality urban poverty levels are high at Gitambaya and Githurai settlements.

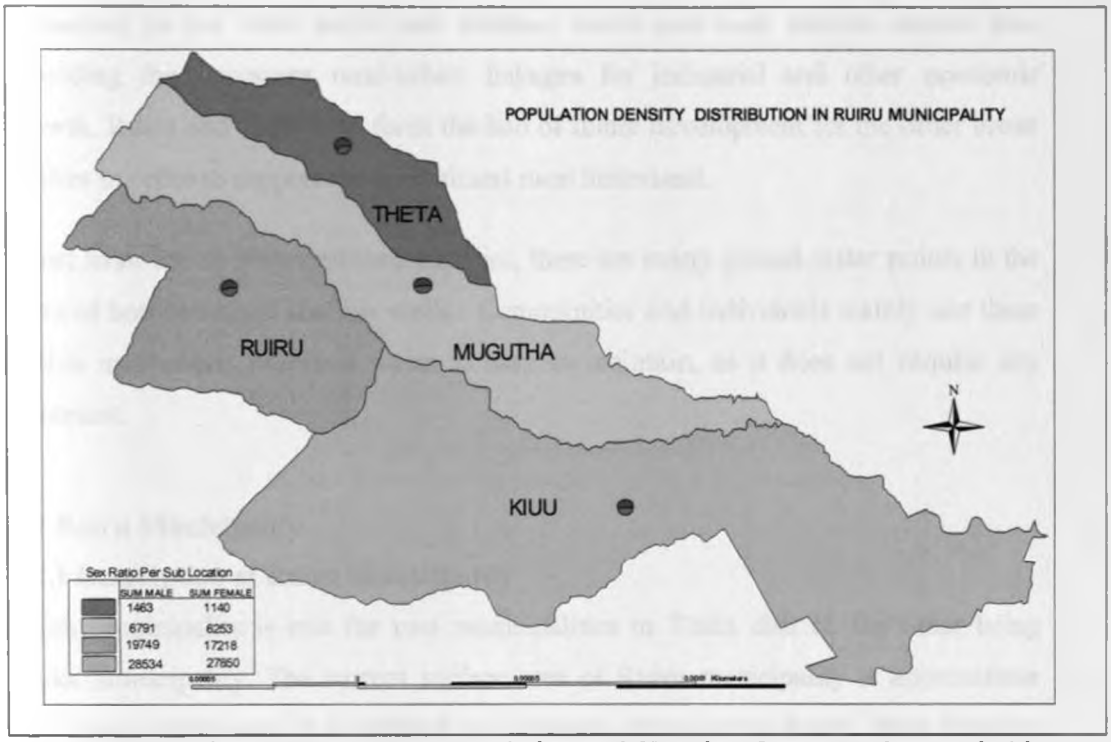
Table 4-4 Population Distributions and Density of Some Selected Units in Thika

	Male	Female	Total	Households	Area	Density
Thika District	323,479	322,234	645,713	171,569	1,960.2	329
Thika Municipality	47,091	42,141	89,232	29,270	93.5	954
Ruiru Division	78,595	72,115	150,710	46,694	526.6	286
Ruiru Municipality	56,982	52,592	109,574	34,274	290.8	377

Source: Republic of Kenya, 1999 Population and Housing Census Vol. I, Nairobi, Government Printer

From table 4-4 above, Mugutha sub-location contributes about 84 per cent of the total population of Murera ward (constituted by Mugutha and Theta sub-locations). The proportion of the study area population to the total population of Ruiru Municipality is in the tune of 12 per cent as of 1999.

Figure 4-5 Population Density Distributions in Ruiru Municipality



Source: Republic of Kenya, 1999 Population and Housing Census Vol. I, Nairobi, Government Printer

4.6.3 Urban Population

Both Thika and Ruiru Municipalities have several industries and factories, which attract migrant workers and job seekers from neighbouring districts and other parts of Kenya. Thika District urban population at the start of the plan period 2002-2008 was estimated at 241,552 (Kenya, 2002b).

It is estimated that this population will increase to 285,226 at the end of the planning period. (Kenya, 2002b). The District's average household size was 3.8 and average poverty level was 48.4 per cent as of 1999. Urban self-employment stood at 19.6 per cent at the same period.

The proximity to Nairobi has also influenced some Nairobi workers preference to reside in the two municipalities while commuting to Nairobi daily. Thus, Ruiru and Thika serve as dormitory towns of the city of Nairobi. This impacts on Land, water

and other resources and service provision within the district. These towns are well connected to the other small and medium towns and rural market centres thus providing the necessary rural-urban linkages for industrial and other economic growth. Ruiru and Thika also form the hub of future development for the other urban centres in order to support the agricultural rural hinterland.

Apart from the above-mentioned supplies, there are many ground water points in the form of boreholes and shallow wells. Communities and individuals mainly use these within institutions. Ground water is easy to maintain, as it does not require any treatment.

4.7 Ruiru Municipality

4.7.1 Description of Ruiru Municipality

Ruiru municipality is one the two municipalities in Thika district, the other being Thika municipality. The current surface area of Ruiru municipality is approximate 292 square kilometers. It is defined by Gatharaini River to the south, Theta River to the north, Tana river to the south and a coffee plantation boundary a few metres west of Ngenda road.

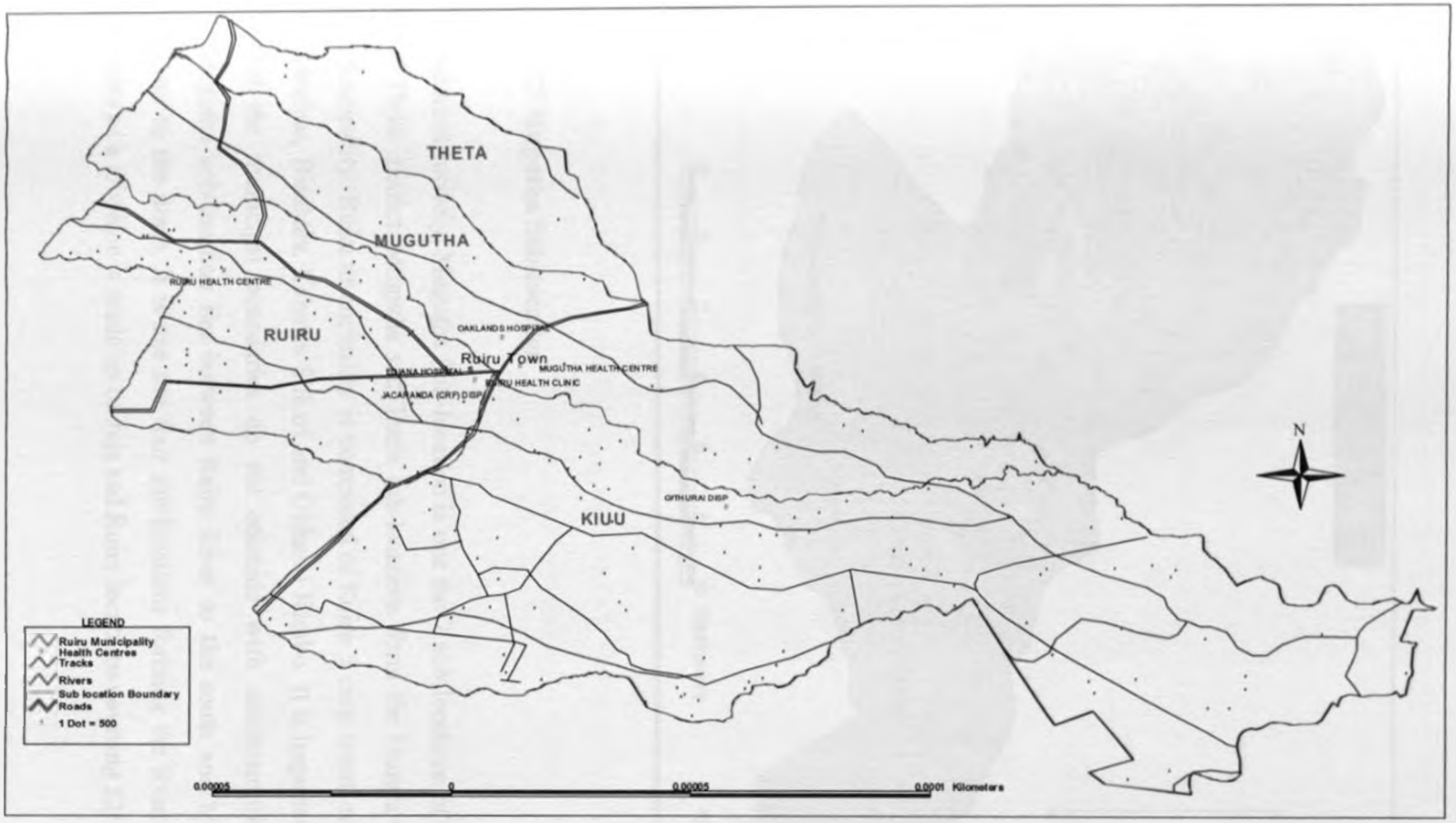
Table 4-5 Administrative, Civic, Area and Population of Ruiru Municipality

Ward	Administrative Composition	Population	Area (Sq.km)
Murera*	Theta & Mugutha sub-locations	15,801	91.6
Gitothua	Part of Ruiru sub-location	18,692	25.1
Biashara	Part of Ruiru sub-location	18,692	25.1
Kahawa Sukari	Part of Kiu sub-location	28,194	74.5
Githurai Kimbo	Part of Kiu sub-location	28,194	74.5
Totals		**109,574**	**290.8**

Source: Ruiru Municipal Council Office, 2006

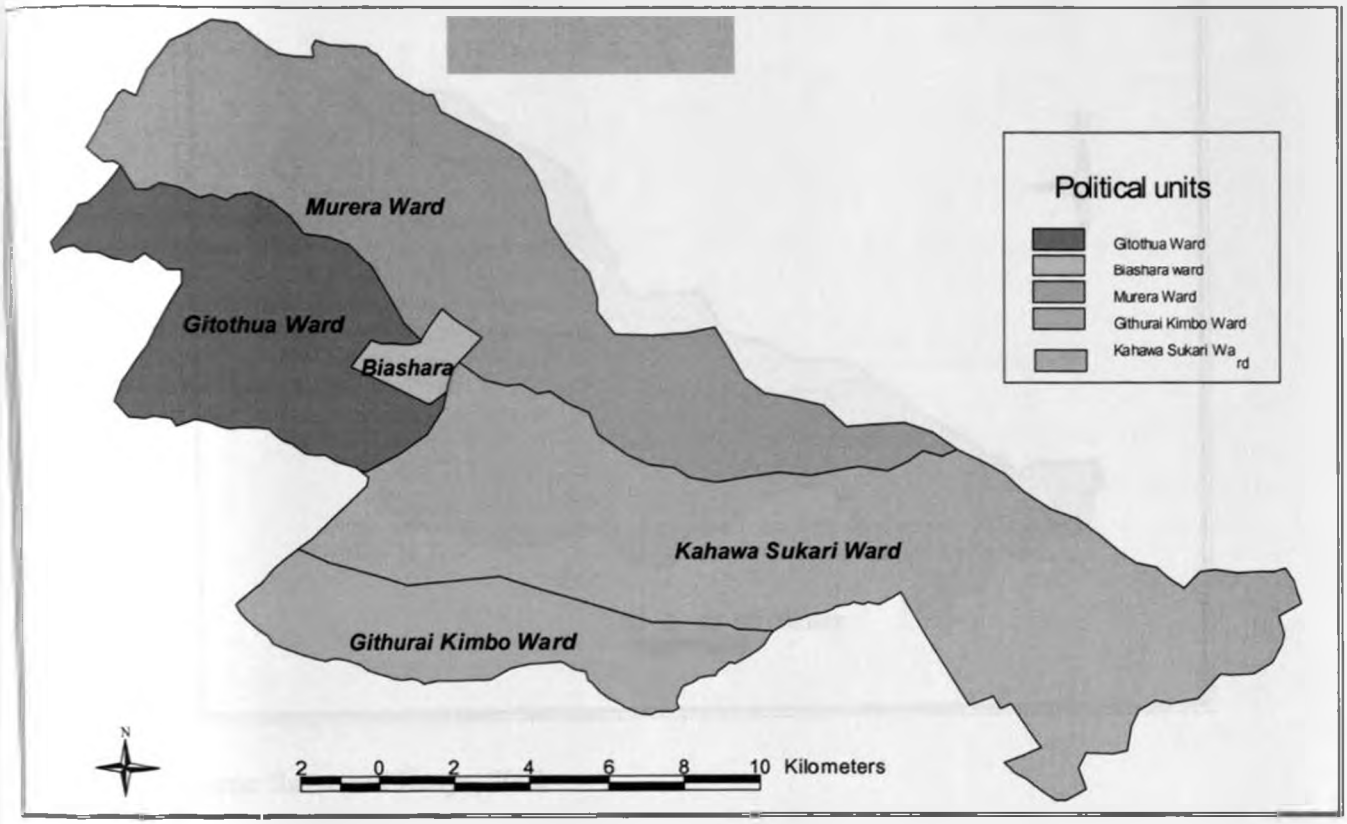
Murera Of 15,801 people in Murera ward, Mugutha sub-location has 13,198 persons while Theta contributes to the rest of the ward population.*

Figure 4-6 Population Distributions in Ruiru Municipality



Source: Republic of Kenya, 1999 Population and Housing Census Vol. I, Nairobi, Government Printer

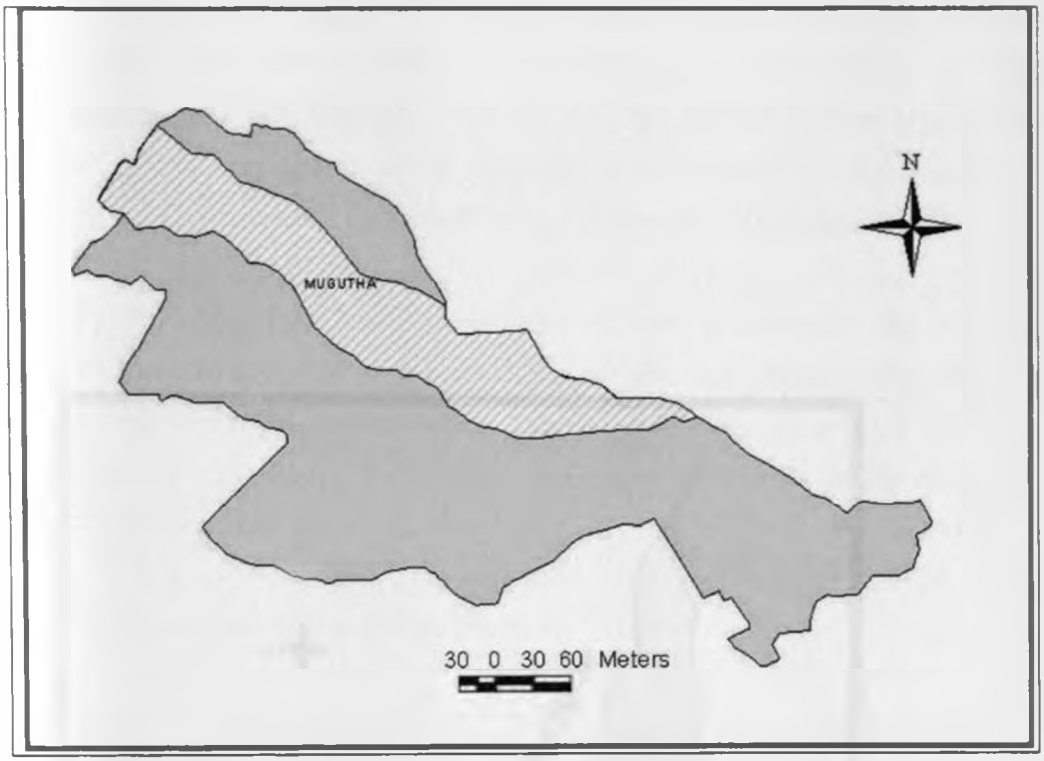
Figure 4-7 Civic Wards That Constitute Ruiru Municipality



4.7.2 Mugutha Sub-location

Administratively, Mugutha Sub-location is one the 7 sub-locations of Ruiru division of Thika district. Mugutha and Theta sub-locations form the Murera ward of Ruiru Muncipality. Ruiru municipality is composed of Ruiru 5 civic wards namely Murera, Gitothua, Biashara, Kahawa Sukari and Githurai Kimbo. It is important to note here that the municipal boundaries do not coincide with administrative boundaries. Mugutha sub-location lies between Ruiru River to the south and Mugutha/ Theta River to the north. It is one the four sub-locations forming the Ruiru municipality. Ruiru as a Division is made up of Juja and Ruiru locations covering 526.6 sq. kms.

Figure 4-8 Mugutha Sub-location in the context of Ruiru Municipality



Source: Survey of Kenya, 2002

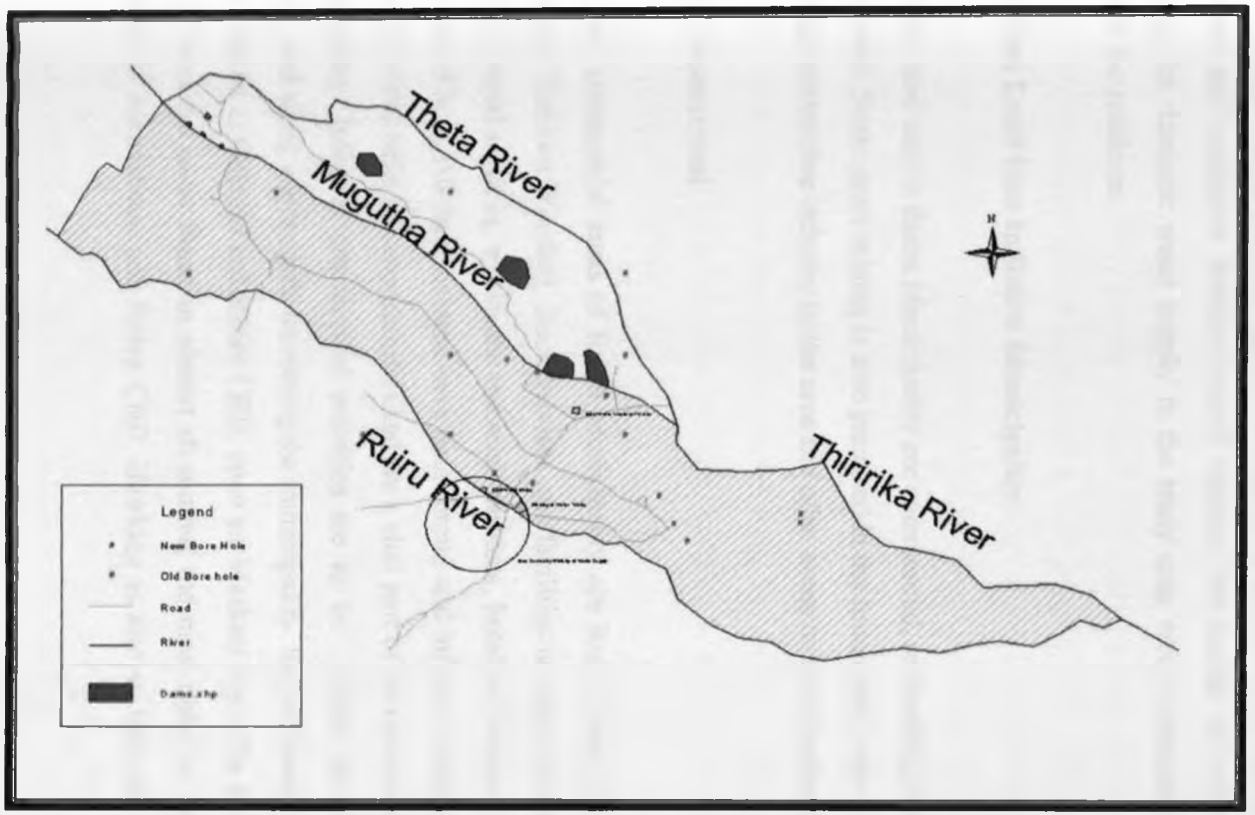
Mugutha Sub-location had a total population of 13, 198 in 1999. The demographic characteristic of this population is a summarised in table 4-7 below.

Table 4-6 Population Distributions and Density of Mugutha Sub-location In 1999

Sub-location	Male	Female	Total	Households	Area	Density
Kiu Sub-location	28,502	27,887	56,389	16,780	149	378
Mugutha Sub-location	6,868	6,330	13,198	3,656	66.4	199
Ruiru sub-location	20,135	17,246	37,384	12,861	50.2	745
Theta Sub-location	1,474	1,129	2,603	977	25.2	103

Source: Republic of Kenya 1999 Population and Housing Census Vol. I, Nairobi, Government Printer

Figure 4-9 Water Resources and Water Projects in Mugutha Sub-location



Mugutha Sub-location is unique in that it forms sparse settlements on former co-operative farms and is currently facing fast urbanization without corresponding planned services such as water and sanitation. Planning for water and sanitation services in such an area before dense settlement occur could militate against possible current and future problems associated with lack of adequate and efficient delivery of these services. The need for planned infrastructure services become even more critical in the face of no current physical development plan situation as is the case with Ruiru municipality.

Thus, the development and management of water and sanitation infrastructure and services is essential to economic growth and poverty alleviation in urban areas. Planning for water and sanitation services would enhance the quality of urban environment. Planning for domestic water supply in the study area would enhance the standard of living of the residents.

4.7.3 Main Land Uses In Ruiru Municipality

The main land uses in Ruiru Municipality are commercial, residential, industrial,, and agricultural. Some stone mining is also practised in the municipality to serve the fast growing construction industry in the area and other areas outside the district.

4.7.3.1 Commercial

The main commercial areas of Ruiru Municipality are Ruiru town, Githurai shopping centre and Kahawa Wendani. Such services and facilities as open-air markets, Banking services, postal services, wholesale and retail services, hotels & restaurants, cyber cafes, etc is found here. All these centres have both formal and informal commercial activities. These activities offer job opportunities and are a vital part of the urban economy of Ruiru Municipality. Informal commercial activities are to be found in almost all urban centres, and along major roads traversing the municipality. Second-hand cloth dealers are to be found at Githurai and Ruiru CBD, open air Markets that offer a variety of goods and services are to be found in almost all centres, the most notable being the one at Githurai 44 roundabout, and Ruiru CBD. Hawking is also an informal activity that is

common in Githurai and Biashara wards. Juja shopping centre, though not part of the municipality forms part of the Ruiru town urban system.

4.7.3.2 Industrial

A number of industries exist in Ruiru town, most located along Kiambu road and a few others along Ruiru River. The industrial processes range from steel and nails production, Permacutical and chemical production, Food and Juice processing, Synthetic and textiles, mattresses, etc. Some of these industrial outfits include: Spinners & Spinners Ltd, Henkel Chemicals, Drum containers, and Sona industries among others. These industries offer much needed employment opportunities to the local residents.

Ruiru in general is suitable for the location of industrial activities due to some favourable factors such as: Large growing population and proximity to Nairobi provide raw materials, labour and market for the goods and services. Good transport network that enables communication and transportation of goods and services. The Nairobi-Thika highway, which is a dual carriage way and the railway line connecting Nairobi and Nanyuki via Ruiru offer good means of transport. Raw material availability and accessibility is another factor that favours industrial location in Ruiru. Raw materials for food and processing industries can be readily availed from the hinterland. There's also availability of suitable cheap land for industrial location, Land use originally planned for industrial use has not been fully utilised.

It is expected that Commercial and industrial activities impacts on water and sanitation demands and provision in different ways and hence the need to plan for them.
However, there exist minimal commercial and industrial activities within the study area. Other than a few retail outlets like Toll station along Thika road, Gwa Kairu next to KU Ruiru campus and Wamuthanji's next to GSU base and Matangini near Bethlem Academy. Industrial activities in the study area are limited to Peaks alcohol brewery. Mugutha is largely planned as a residential.

4.7.3.3 Agricultural

Although, designated as urban, agricultural activities are common. They are carried out both in large scale and small scale. They range from zero- grazing, poultry, pig rearing,

open field grazing, and kitchen gardening to horticultural and floricultural farming. Large-scale Dairy farming is carried out in Gicheha farm, which is a subsisdiary of Broookside Diaries. Milk from both the farm and from the hinterland is processed within the farm. Various milk products such, as the famous Brooke side milk, yoghurt, butter, ghee, etc are manufactured. A significant number of Mugutha residents keep livestock as a way of supplementing sources of food and income. Dairy cattle and milk goats are mostly zero-grazed while Indigenous cows; goats and sheep are grazed in the open fields. Floriculture is practiced in large-scale basis for the export market around the prison college.

Coffee farming is practiced at a large scale in the upper parts of the municipality where the soils are favourable and irrigated during the dry season from the series of dams along Mugutha River. These coffee farming enterprises include Scorfinaf, Mboi- Kamiti, Danga farm where coffee is mixed with Makandamia. Twiga coffeee farm is set for subdivision and as such the coffee trees have been cut down and subsistence maize and beans farming is carried out during the rains. Ruiru coffee research station is located within the coffee growing area and its here where research on coffee varieties to meet different ecological zones is undertaken. High rate of land conversion from agricultural land to residential and commercial land use has the implication of rising the population and inherent human activities. Agricultural activities are heavy consumers of water and contribute significantly to sanitation problems in peri-urban areas.

4.7.3.4 Residential

The main land use- destined to take a higher portion of the municipality land due to population pressure in larger Nairobi metropolitan area. Mostly on quarter acre plots, the existing settlement patterns take the form of nucleated settlement at Central Business District (CBD), Githurai, Kahawa Wendani and Kahawa Sukari; linear form of settlement along the Nairobi- Thika Highway, and dispersed settlement of individual residential plots all over the municipality. This is the typical settlement pattern in the study area. Institutional residential houses are found at Ruiru prison and staff training college, at Ruiru General Service Unit (GSU) base, and various boarding schools and colleges. The G.S.U settlement has its own water works for its exclusive use. The nature

and pattern of residential settlement has a bearing to the ease or otherwise of provision of water and sanitation services.

4.7.3.5 Mining

Several quarrying operations for stones, ballast, murram and hardcore exist. The demand for construction materials is high both within and outside the municipality. Large-scale machine stone mining activities take place within the periphery of Ruiru municipality such as at Ndarugu area. Small-scale mining activities occur along the rivers and around dams either on individual parcels or on riparian reserves thus degrading the general environment and water resources. Open mining pits are common in the study area as a result of unregulated mining posing danger to both health and security of the area residents. However, land reclamation is common in the formal mining sites.

4.8 Infrastructure and Services

4.8.1 Water and Sanitation

Thika and Ruiru are the fast growing towns in the district. However due to the fast development of industries coupled with high population pressure, there is significant pollution levels Pesticides used in agricultural undertakings have also led to pollution of rivers and the environment. Other environmental concerns in the municipality include the mushrooming of unplanned structures in Juja and Githurai towns making environmental sustainability difficulty to be realised (Kenya, 2002b).

Generally, water and sanitation situation in Ruiru municipality is not good. Only a small proportion of the municipal residents are connected to pipe water and majority rely on rain harvesting and ground water sources for their water needs. The quality of ground water sources is may be questionable and rain harvesting depends on erratic rains in the area. The ministry of water and the Nairobi City Council piped water supplies covers a limited area and even then the supply is not reliable. The Nairobi City Council supplies water in some parts of Githurai, Kahawa Wendani, and Kahawa Sukari, while the ministry of water supply to the CBD, Gitambaya, Industrial area, Murera and Kimbo.

The Nairobi City Council supply is not a permanent supply line, as it was never meant to serve Ruiru residents in the first place. Wells, rain harvesting, rivers and dams also do provide sources of water especially in the outskirts of Ruiru town and especially in Mugutha sub-location. Shallow wells are increasingly becoming an important alternative source of domestic water in the households despite the risk of possible water pollution from widespread usage of pit latrines in small parcels of land and effluent from agricultural activities and storm water.

Rivers and dams are also prone from siltation and pollution from various human activities in the area. As such these water sources are not reliable for domestic water supply unless measures are put in place to conserve them. Dams are also concentrated along Mugutha River and even then only two are accessible conveniently to some section of the population. Due to irrigated coffee farming and processing these sources of water have their quality compromised. Effluents from industrial and solid waste dumping pose a real threat to their sustainability as a source of domestic water.

Storm water drainage in the municipality in general and Mugutha sub-location in particular is very poor. Consequently, flooding during the rainy season is the order of the day. This present a big transportation and health problems, as most access roads become impassable and stagnant waters acts as mosquito breeding grounds. Ground water resources are also adversely affected by this condition as the water level rises making pollution possible (Field Survey, 2006). Currently the municipal authority is constructing a drainage channel so as to drain one of the eyesore areas of the municipality ('the stadium') within the town's CBD, which is flood during the rains.

Plate 4-1 Drainage Channel under Construction in Ruiru CBD

4.8.2 Transportation

Ruiru Municipality is well served with road and rail network. Transportation is a vital component of an urban land use system as it offers a means of linkage of various land uses, which are more often than not, located on different sites. The main purpose of transportation is to link or facilitate the movement of people, goods and services from one place to another, i.e. between and within settlements.

Encroachment of road reserves is common in Ruiru especially in the Gitambaya area thus affecting planned development, including public utilities like water supply. In most parts of the municipality the way leave integrity is compromised by this encroachment of road reserves by human activities such as vending, construction, farming, and lack of drainage. The municipal council maintains the roads within the municipality while the trunk road is maintained by the central government.

The major roads include: A2 (Thika- Nairobi) – a National Trunk road passes through the municipality. This road is an important link between Ruiru and the higher order

service centres such as Nairobi, Thika, Nyeri and Enbu. It is important means of transportation for the raw materials, goods, people and services. The proximity of Ruiru to Nairobi and Thika makes its convenient to daily commuters as is within commuter range. Currently Thika road is not in good condition and suffers serious traffic jams in the rush hours.

Various modes of transport are used by Ruiru residents and include Boda Boda, Personal cycling, Public transport (Matatus), personal cars, and the rail transport. Other major roads that serve to promote rural urban linkages activities of Ruiru Muncipality are: C63 (Ruiru- Kiambu) Primary distributor- C65 (Ruiru- Githungiru) Primary distributor. D398 (Ruiru-Kiganjo) secondary distributor-traverses through Mugutha. Most access roads especially in residential areas are yet to be opened up.

Generally the access roads in the study area are in a sorry state. Most of them are either poorly drained or not drained making them literally impassable during the wet season as indicated by plate 4-2 below. This condition affects both motorised and non-motorised modes of transport within the Municipality.

Plate 4-2 Poor Road Condition In The Study Area

Railway Transport The Nairobi- Thika- Nanyuki railway line enhances transportation services. It serves residents of Ruiru municipality via the commuter Nairobi - Githurai – Ruiru- Thika train. Rail transport is cheap and cost effective for transportation of bulky goods. As such the industrial establishments in Ruiru greatly benefit from this service.

4.8.3 Housing

Ruiru Municipality has high, medium and low-density housing. The quality and type varies across the municipality. Few institutional and municipal council houses exist. Private developers and individual house ownership largely meet the deficit. In the study area most houses are permanent in nature can be said to be of low to medium density class. Most houses are private residential units largely without attendant infrastructure services including water and sanitation as indicated in plate 4-3 below.

Plate 4-3 Housing in the Study Area

4.8.4 Power

Ruiru Municipality enjoys to a large extent good electricity connection especially the Central Business District. Provision of such utilities as electrical power can go along way in enhancing service delivery, key among them being water and sanitation services. Though some parts of the study area are connected to electrical power, the vast areas of Mugutha are yet to enjoy this service. However, currently there is an ongoing electrification programme in the fast urbanizing areas of the sub-location as indicated in Plates 4-4 and 4-5.

Plate 4-4 Ruiru Power Sub Station

Plate 4-5 Ongoing Electrification in the Study Area

Going by the scenario in the previously connected parts of the municipality, power connection facilitates electrical water pumping from shallow wells thus promoting water accessibility.

4.8.5 Health Facilities

There is a sub- district hospital in Ruiru town. And a host of private clinics and two private hospitals that supplement in the provision f health services. The institutional health services provided by security and correctional institutions namely Ruiru GSU base and Ruiru Prison and Training College supplements the provision of health services. Most residents of the in the study area seek health services from both private clinics and public health centres. The G.S.U health facility is particularly useful to the low-income population. These health facilities are consumers of domestic water and draw their water needs from the various water sources in the Municipality. Health facilities demand reliable water connection and the best sanitation conditions for sustainable health living and hence planning for their water supply contribute to promotion of good health living of the residents and a healthy environment.

4.8.6 Educational Institutions

There are a number of public and private schools (primary and secondary levels). Kenyatta University Ruiru Campus is locating in the study area, though its interaction with the local economy is minimal. Secondary schools in the study area include Murera, St. Lindas, and Ruiru secondary schools. These secondary schools have their own boreholes water supply. KU Ruiru campus relies on both borehole and ministry of water supply, with the ministry's supply being the main source of water for the institution. These facilities are major water consumers and hence major contributors to sewage matter, which has a bearing to sanitation condition of the municipality.

Plate 4-6 High Capacity Storage Tank

This high capacity storage facility is meant to serve the school below Plate 4-7) as well as the neighboring community on commercial bases both at point of sale and reticulated water service.

Plate 4-7 Tumaini Junior Academy

A host of private primary schools and a few public primary schools exist in Mugutha sub-location. Such schools include Bethlehem Academy, Wankan Academy, Highway view Academy, Fathers House Academy, Kimbo Academy, Spirit of Faith. Wankan , Spirit of Faith and Bethlehem academies have their own boreholes water supplies.

CHAPTER FIVE

DATA ANALYSIS AND RESULTS

5.1 Introduction

In order to address the set study objectives, the field undertaking sought to gather data and information on sources of domestic water supply, quantity and quality of accessible water for domestic use, equity and coverage levels of domestic water supply, among others. Data and information pertaining to sustainability issue was also collected in both quantitative and qualitative form. Current and future domestic water demand is computed in order to assess the adequacy or otherwise of the existing water resources in the study area. Policies, strategies and legal and Institutional framework guiding and steering water sector planning, development and management were given a detailed overview, including the country's initiatives towards meeting the sector's Millennium Development goals.

The data collected is analysed and presented under the following headings:

5.2 Household Characteristics

Majority of households were male headed (71 per cent) and the average household size was 4. About 64.7 per cent of the households had 1 to 3 children while 23.5 per cent had between 4 and 6 children.

Figure 5-1 Genders of Household Head

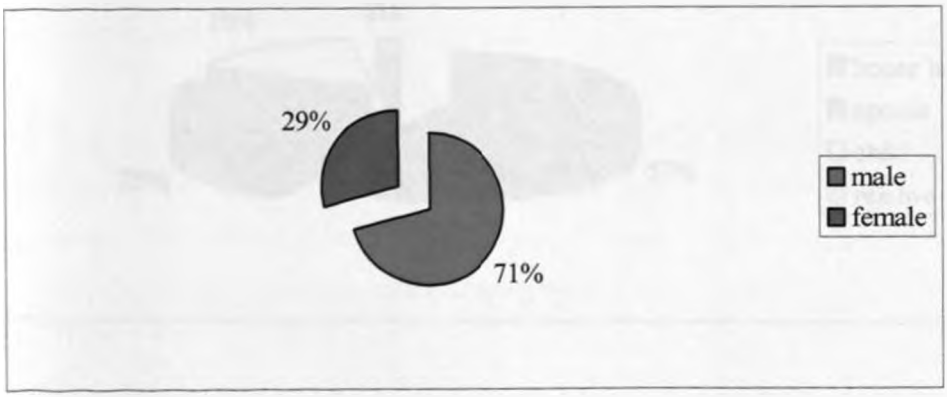
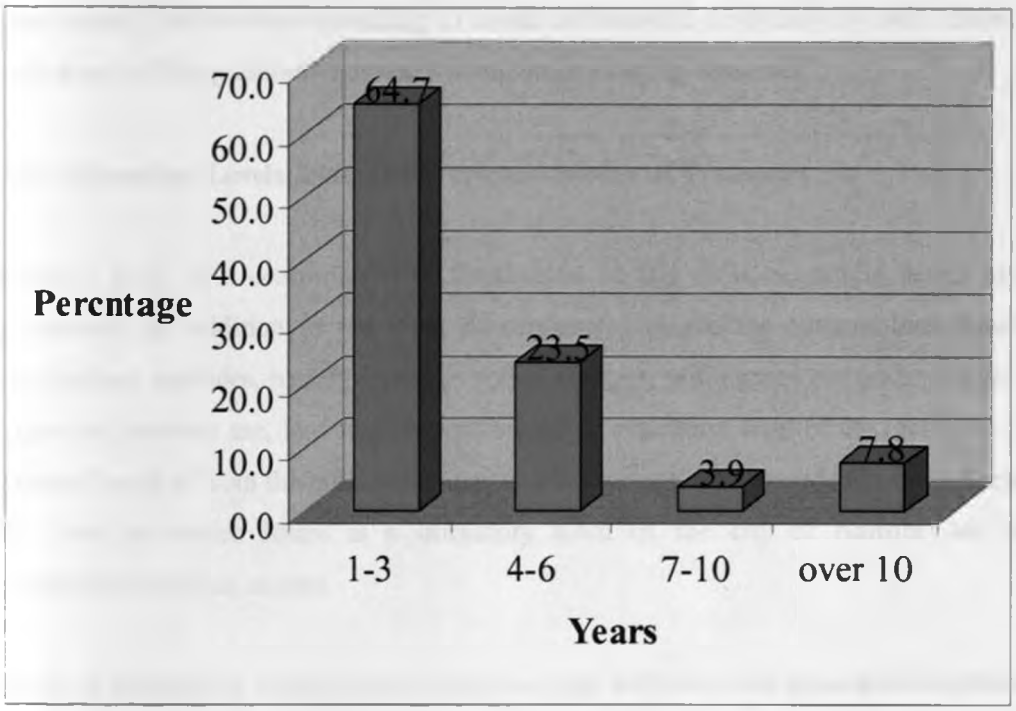
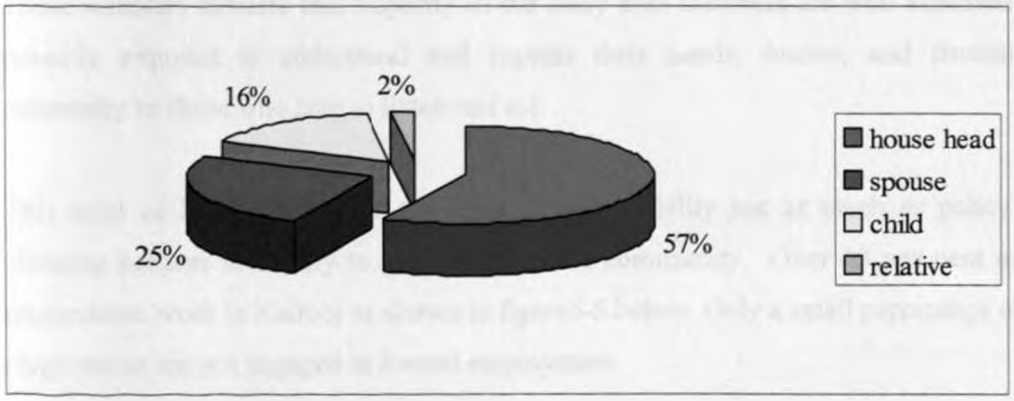


Figure 5-2 Numbers of Children in the Household



In the study, 57 per cent of the respondents were the actual house heads, 25 per cent were spouses. The rest of the respondents were either children (16 per cent) or relatives (2 per cent).

Figure 5-3 Respondent's Relationship with Household Head



The household whose potential respondent was to be a servant were deliberately avoided so as to minimize cases of outliers and missing information (information gap). Due to the urban nature and high turn over of the servants, these servants are likely to be inadequately informed or unwilling to reveal information pertaining to their bosses. As such most of the questionnaires were administered during weekend.

5.2.1 Education Levels, Places of Work and Modes of Transport

Literacy level of a community has implication on the social-economic status of that community in addition to the level of exposure. Hence the communities members perceptions, attitudes, receptiveness to policy changes, willingness and ability to pay for improved services are, to a large extent related to education level of the residents. The place of work of both the household head and the spouse were recorded in order to gauge the level to which Ruiru is a dormitory town of the city of Nairobi and other neighbouring urban centres.

Mode of transport to various places such as school and other vital areas also contribute to assess time and financial resources left to meet household domestic water needs. Majority of the household heads had post secondary education in that 23.5 per cent had University education, a similar percentage had college education, and 35.3 per cent had secondary education while 15.7 per cent had attained primary education level. Only 2 per cent had no formal education status.

These statistics indicate that majority of the study area members are well educated and possibly exposed to understand and express their needs, desires, and frustrations coherently to those who care to listen and act.

This level of literacy enhances the issue of sustainability just as much as policy and planning process are likely to gain from such a community. Over 40 per cent of the respondents work in Nairobi as shown in figure5-5 below. Only a small percentage of the respondents are not engaged in formal employment

Figure 5-4 Education Levels of Household Head

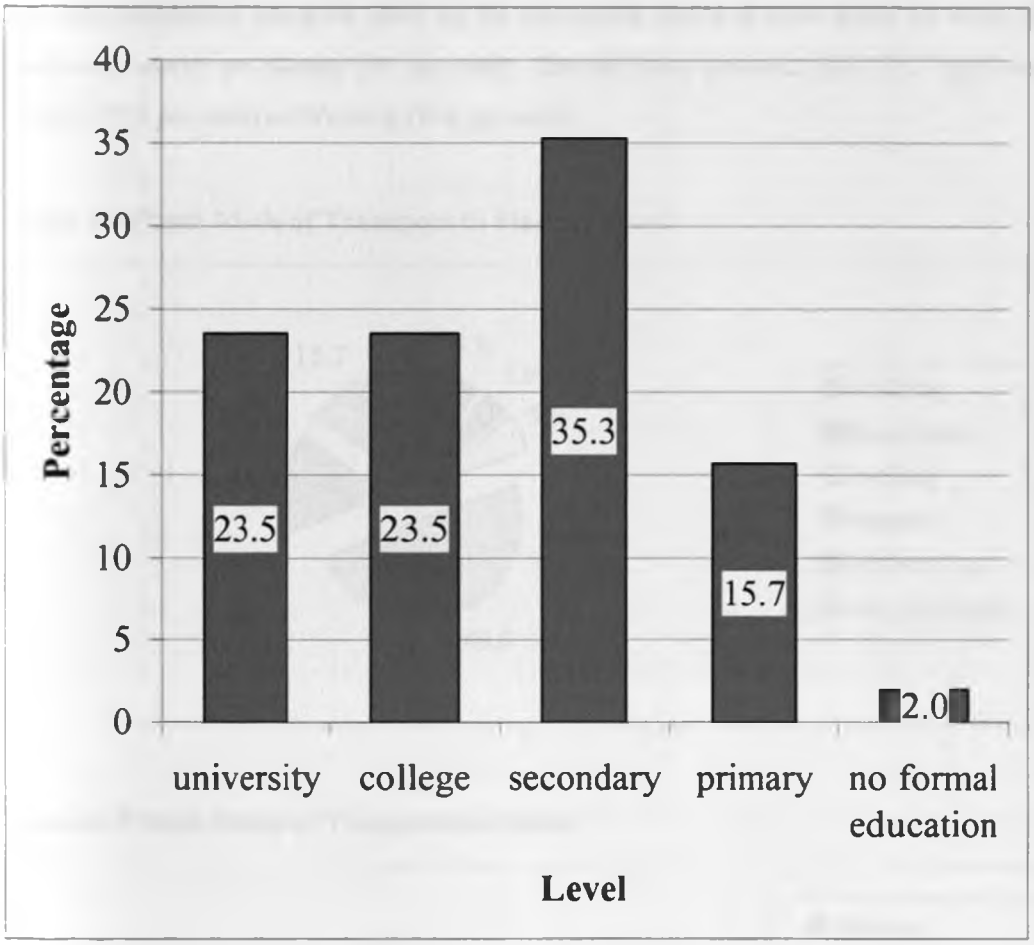
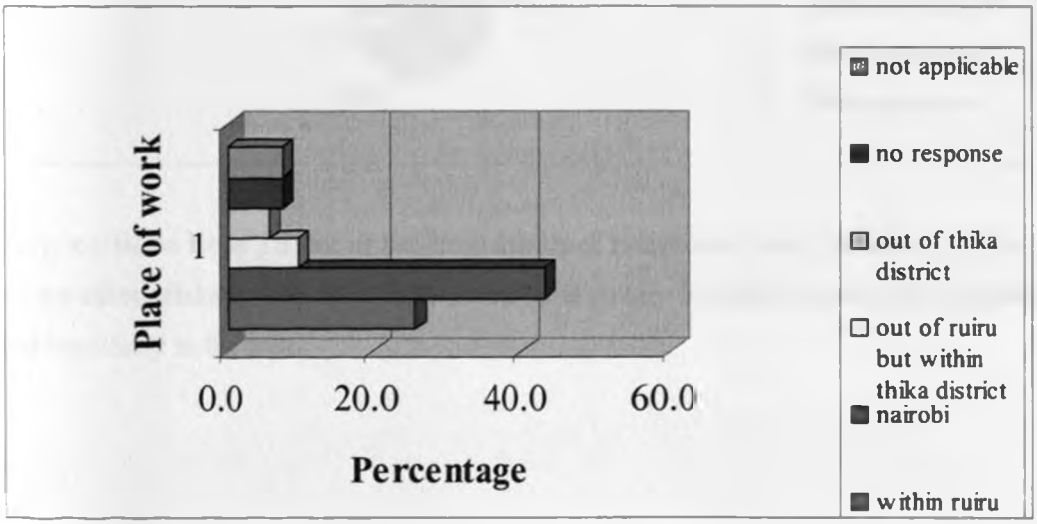


Figure 5-5 Place of Work of the Household Head



The main modes of transport used by the household heads to their place of work (for those who work) are Matatu (49 per cent). The rest uses personal cars (15.7 per cent), Cycling (5.9 per cent) or Walking (9.8 per cent).

Figure 5-6 Main Mode of Transport to Place of Work

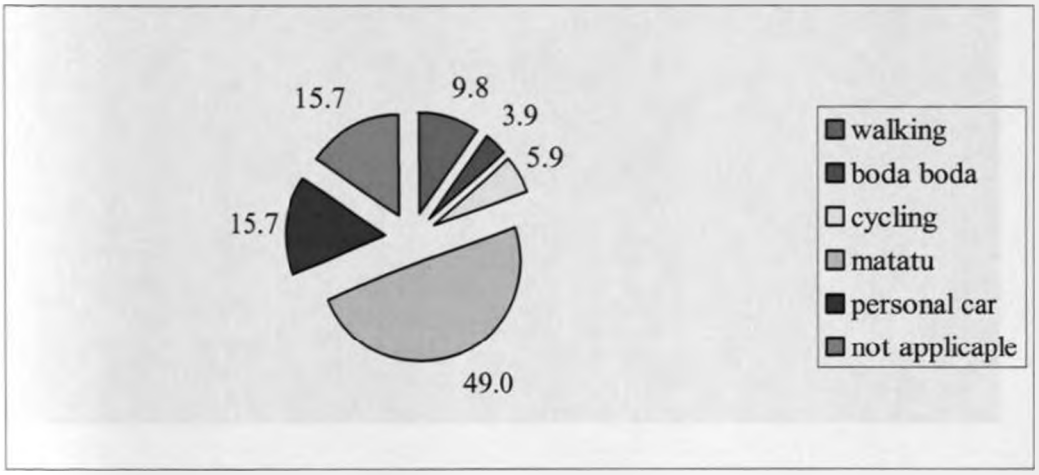
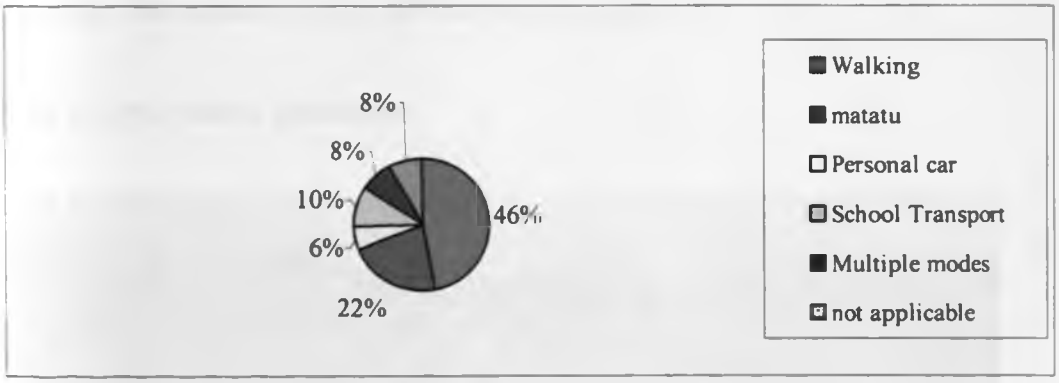


Figure 5-7 Main Mode of Transport to School



Bicycle ('Boda Boda') is one of the main modes of transport to work, to school and to access other vital services. This mode however is greatly limited by poor road condition and insecurity in the area.

Plate 5-1 Bicycle Mode of Transport

Poor Roads Conditions are common in Mugutha making accessibility of domestic water and other vital services not only difficult but also exorbitant

Plate 5-2 Poor Roads Conditions

5.3 Urban Agricultural Activities in Mugutha Sub-location

The peri-urban area of Mugutha sub-location is largely rural in nature with limited commercial and industrial activities. Due to relatively large land parcels, ranging from ¼ acres to 2 acres and good soils especially in the former coffee zones, majority at households (52 per cent) engage in some form of urban agriculture. This could range from subsistence farming, kitchen gardening, poultry keeping, to livestock keeping.

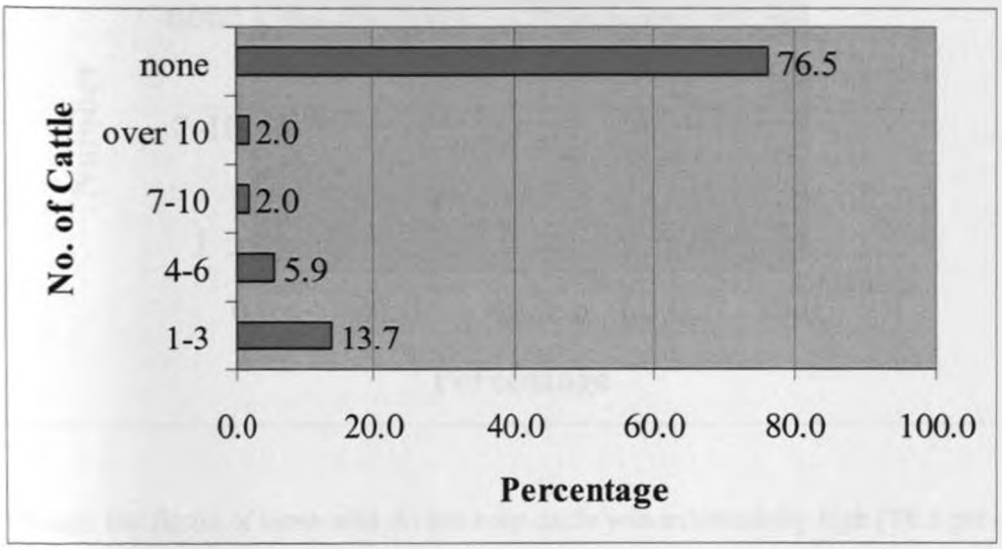
Urban agriculture is popular in Mugutha as a variable source of food and a source of income too and yet to others it is a hobby (See Plate 5-3 below).

Plate 5-3 Urban Agricultural Activities in Mugutha Sub-location

Unfortunately, none of the respondent's interviewed engaged in horticulture despite the favourable climatic and soil condition lack of reliable rainfall and irrigation water may explain this gap. A few households (33.5 per cent) keep some cattle of which 13.7 per cent have 1-3 No. Cattle while 2 per cent have over 10 cattle as shown in figure 5-8

below. Most of the households with large herds of cattle actually rear Zebu's or traditional or even cross breed, which are normally grazed in the open unoccupied parcels of land.

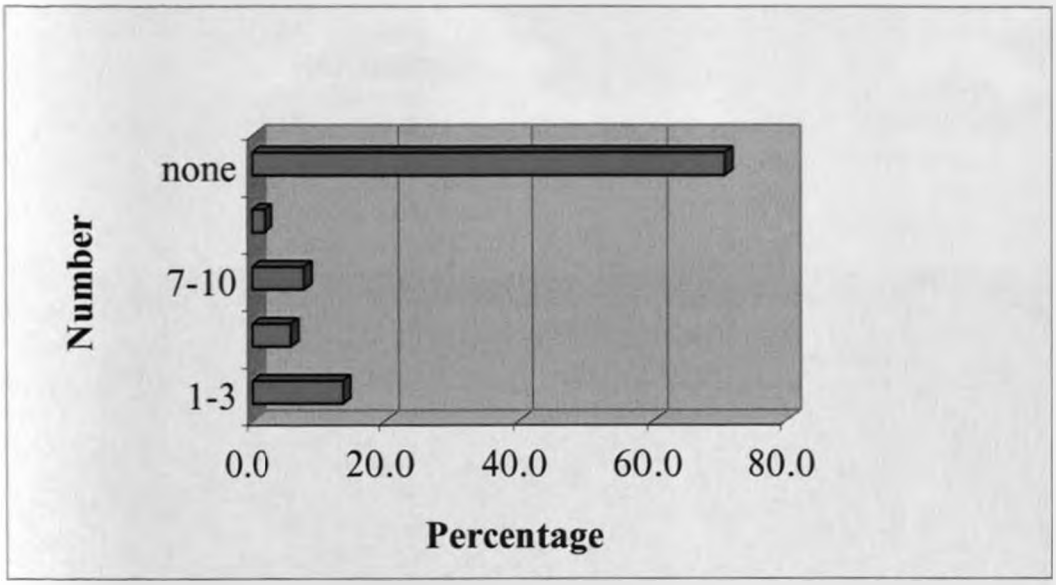
Figure 5-8 Percentages of Households with Cattle



Those who keep 1-6 cattle normally rear daily cattle as a means of extra source of income and to meet the household's milk demand. As such Napier grass is either grown on parts of household land or on hired/leased unoccupied parcels. The manure so produced enhances soil fertility further enhancing land productivity. A few respondents keep poultry for eggs but surprisingly none kept pigs. The urban agriculture activities support agro-chemical based business in Ruiru and other commercial outlets all over the municipality. The sub-sector is also a major employer and definitely a reliable source of extra income. Certainly, these urban agricultural activities impact on water demand at household level as shown in water demand computations.

Goats and sheep are popular in the study area either because they consume relatively low amount of fodder compared to cattle or they can be left to roam or pegged in the unoccupied parcels without much a do. A few households have donkeys for water and other cargo transport including building materials.

Figure 5-9 Numbers of Goats and Sheep Reared Per Household



Though the figure of those who do not keep cattle was substantially high (76.5 per cent), most households' respondents indicate they would wish or eventually rear them. This applied mostly to new settlers. On the other hand, a significant number of those already rearing cattle would eventually replace them with commercial land uses due to rising demand for land for either rental housing or normal residential housing, a pointer to eventual subdivision. This would raise the domestic water demand further. For non-zero grazed cattle, goats and sheep, rivers and dams provide a useful source of livestock water. Open cattle, sheep and goats grazing in non-occupied land parcels are common due to sparse nature of settlement as shown in plate 5-4.

Plate 5-4 Opening Grazing in The Study Area.

5.4 Housing

About 86.3 per cent of respondents' houses were permanent in nature while (5.9 per cent) were temporary and 7.8 per cent semi-permanent. It is important to note that a significant number of people have harvested water from their roofs especially those whose houses are iron-roofed. The housing class range from low to medium to high-class palatial homes. Despite the presence of these permanent classes of houses, commensurate classes of infrastructure such as good roads and pipe water are lacking

Figure 5-10 Nature of Main House in the Household

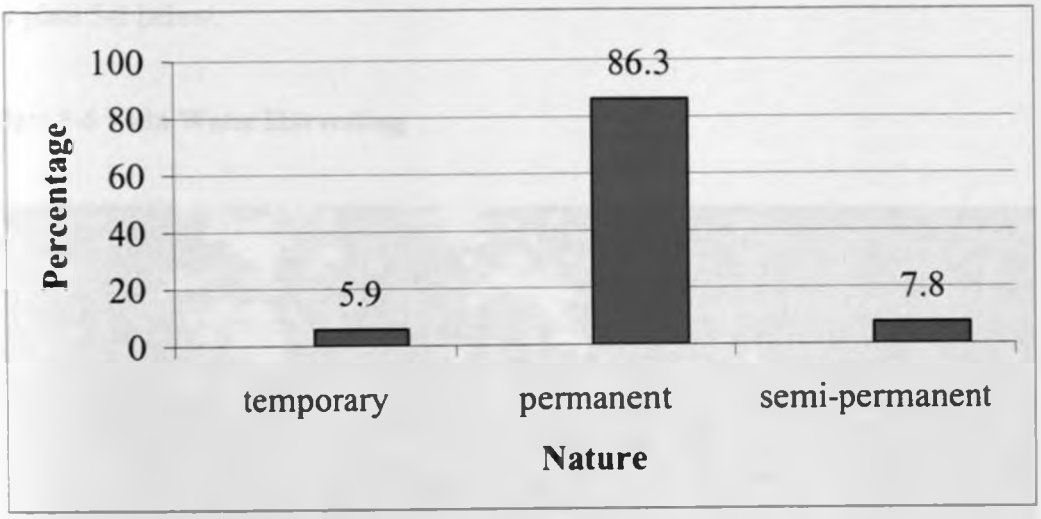


Plate 5-5 House Type

Rain Water Harvesting is a common and a useful source of Domestic Water as indicated by plate 5-6 below.

Plate 5-6 Rain Water Harvesting

However, the housing aspects in the study area remain incomplete as many of the houses are yet to be facilitated by essential infrastructures and services such as piped water, sewerage and power and well-maintained access roads.

Lack of or inadequate development control affects the design, quality, layout and plot ratios negatively. Inappropriate land uses and way leave are not uncommon especially around commercial areas. This would make the eventually extension of water supply difficult and expensive if not checked in time.

5.5 Sources of Domestic Water in the Study Area

5.5.1 Ministry of Water Supply

Ministry of Water Supply now under the Athi Water Service Board (AWSB) draws its water from Ruiru Water Works which is situated about ½ km from Ruiru town CBD and adjacent to Nairobi-Thika road to the east. The water works derives its water from Ruiru River, which has several tributaries upstream. The river is also used for irrigation purposes. The Ruiru G.S.U Water Intake Works is also located on Ruiru River. The dry season average discharge of the river is 0.03 cubic metres per second on average according to the district water office hydrologist. This small Water Works was designed for a small population of less than 800 households. Today the water works cannot serve more than 10% of the population

Plate 5-7 Inadequacies Of Ruiru Water Works

Today, Ruiru Water Works has a treatment plant that is composed of two sedimentation tasks of $45m^3$ capacity each and one composite unit with a capacity of $60m^3$.The treatment works discharges between 650 and $800m^3$ per day of treated water at a rate of $35m^3$ per hour. The raw water which is of varying quality through the year undergo the normal treatment process of sedimentation, coagulation and flocculation and chlorination before being pumped to a single elevated tank for onward distribution. The level of treatment varies with the amount of turbidity and raw water pollution depending on the season and industrial and agricultural activities upstream.

The high level of turbidity due to upstream agricultural activities raises the amount of chemicals required to treat the water for domestic use.

Plate 5-8 Turbidity of Ruiru River During Rains

According to the chemical attendant, the amount of Aluminium sulphate used could range between 50kg to 150 kg depending on raw water turbidity levels. The amount of other chemicals used such as sodium carbonate and chlorine similarly depend on pollution levels upstream. Mainly coffee pulp greatly lowers the raw water quality during coffee harvesting season making the taste of treated water distasteful. Occasionally, industrial discharges (untreated) affect the raw water quality and hence the level and cost of treatment of water for domestic use.

Treated water is distributed to residential, commercial and industrial users in a rationed manner as the demand far outstrips the supply. The local water offices estimates a daily water demand have about 10,000m^3 against a daily supply of about 725m^3 on average. Thus the supply is less than 10 per cent of the total demand for the entire municipality. This estimated demand does not include areas being served by the Nairobi Water and Sewerage Company.

The Ministry supplied areas are the Ruiru town, Gitambaya, part of Murera, Kimbo Industrial area, Ruiru sub-district hospital and Ruiru's Kenyatta University Campus. The factories and Gitambaya settlement get their share of supply during the day and early in the morning while the CBD and other residential areas receive their supply during the day. Kimbo and Ruiru's Kenyatta University campus are supplied directly. The total extent of coverage is about 4.5km^2 though the network is not densified yet. It is important to note that the supply to industrial establishment is far from their demand.

The Ministry of Water official apportion the water supplied to various categories of users as 15 per cent residential, 15 per cent industrial, 30 per cent commercial and 40 per cent industrial. The same water officer puts the police lines, Ruiru hospital and Ruiru Kenyatta University Campus as some of the heaviest institutional consumers with the campus consuming between 1500m^3 and 1800m^3 per month. She also observes that most industrial establishment have sunk own bore holes to meet their water demand though given an opportunity they would go for ministry's supplies as the capacity and treatment of borehole water is limited and expensive compared to ministry's supplies.

Cases of vandalism are few, so are cases of illegal connection, problems of unpaid bills and water leakages are, according to the water officer are 'few and normal'. Within the

CBD where both the ministry and a private service provider supplies domestic and commercial water, cases of conflict have occurred and the ministry has lost some of its clients to the private provider despite the seemingly higher cost per litre charged by the private water service provider. This borehole source situated in town centre serves over 10 storeys residential cum commercial buildings each with 2-4 floors with piped reticulation network. The provider also operates a kiosk that provides hundreds of Ruiru residents with domestic water. The borehole is said to be about 600ft deep and seemingly the yield is quite high. Nevertheless, the possibilities of water pollution are real due to over flowing septic tasks in the vicinity and poor drainage of the town.

5.5.2 Ground Water Sources

Information collected in the field from key informants indicates that the ground water aquifers in Ruiru are rich. As such ground water offers a reliable potential source of domestic water if exploited. Indeed going by the multiplicity of boreholes and shallow wells in the municipality, it's evident that groundwater resources pray a pivotal role in water provision in the study area. However, most of the boreholes in Mugutha Sub-location are private and no inventory of shallow wells has been undertaken in the area so far. Most boreholes depths in the study area average between 110m–130 m with a safe yield of 2 – 8m^3/hr. Some of the boreholes characteristics sited include: - Murera Administration Police Post's-80m deep with a tested yield of 5m^3/hr; Nyakinyua's- 76m deep, yield 8m^3/hr; Spirit of faith children home's-156m deep, yield 1.7m^3/hr; Jacinta's-130m deep yield 7.92m^3/hr; 1854 Murera secondary school's recently rehabilitated by Plan International-depth 94.2m, yield originally 13.6 but now only 4m^3/hr.

Murera Borehole water project was rrecently rehabilitated using CDF funds to enhance adequacy and equity domestic water supply in the arid areas of Mugutha.

Plate 5-9 One of The Oldest Community Borehole Water Projects in The Study Area

5.5.3 Rain Water Harvesting

The permanent Secretary Ministry of Water and irrigation sees a lot of Potential in rainwater harvesting and storage. He views it as reliable alternative to conventional water supply systems as it is cost effective intervention under precautionary threats or damage to the environment. Harvesting of surface run off water for livestock use and agricultural development should be enhanced while on the other hand, roof rock and other suitable natural ways of harvesting rainwater for domestic use needs to be put in place.

5.5.4 Institutional Supply

a) The Kenyatta University- Ruiru Campus Water Supply

The Kenyatta University Ruiru Campus with two boreholes of 84m and 110m deep respectively still has to supplement its supply from AWSB. With a population of about 1,400 on average, the Ministry of Water Supply to this campus is far from adequate especially in absence of borehole water during power blackouts and bore repairs.

Currently the borehole usage has been stopped temporary by the public health office due to some suspected contamination of ground water.

Due to the nature of the reticulation system in the campus, only one borehole could be used as a time making it difficult to fill the high storage capacities that exist in the campus. The campus has 3 ground tanks with a capacity of 10,000 litres each and not less than 12 elevated tanks of 2,300 – 2,500 litres each. The officer in-charge of maintenance indicates that despite the apparent abundance in storage capacity, sometimes the campus has to bring water from private borehole vendors to supplement due to high usage of water in the campus.

Unfortunately, neither him nor the water operator has an idea of the total water demand or even supply (from both boreholes and ministry's supply) as of now. However, the monthly water bill to the ministry of water alone, though it fluctuates may be as high as Ksh. 240,000. There exists a perception that this source of water is very expensive, much more expensive than ground water sources. The ministry's tariff structure is such that for domestic use $10m^3$ per month is charged (10,000 litres) a flat rate of Ksh. 200. From 10-$20m^3$ ksh. 25 are charged for $1m^3$ of excess and this rises to Ksh. 30 for every $1m^3$ of excess water. This probably explains why the bulky water users like Ruiru's Kenyatta University Campus pay heavily for their supply. This may also explain why some of the commercial users have opted for fitting many meters instead of paying through master meters.

b) Ruiru General Service Unit Water Works

The base used to depend on two (2) boreholes for its water needs for a long time until recently when a fully-fledged water works was constructed. The system draws its water from Ruiru River upstream of the Ministry of Water Intake and industrial establishment, thus ensuring relatively more reliable source of raw water throughout the year. The intake is about 1.8km from the GSU base and has three powerful electrical pumps of 50HP each, which operate one at a time. This fills the $500m^3$ capacity raw water tanks in 31/2 hours.

On treatment, three pumps each 20 pumps clean water to elevated tank, one operating at a time. The elevated tanks and the clear water ground facilities can store adequate water for 3 days as the daily demand ranges between 150-180m^3 against a daily supply of 500m^3. The resident population is about 400 at any one time. However, according to a water officer based in the base, if the water were to be shared to the community, more elevated water tanks would be required in addition to pumping for more than three and half hours at the intake daily.

Ruiru G.S.U Water Treatment Works has a much more capacity than the current G.S.U population needs. The facility could be utilized to mitigate water shortage in the neighboring community.

Plate 5-10 The Excess of Ruiru General Service Unit Water Works

5.5.5 Community Water Projects

a) Murera Borehole Water Project

National Water Corporation and Pipeline on behalf of the Athi Water Services Board sank Murera Borehole Water Project early 2006. The government through the Ministry of Water and irrigation funds the project; at least as far as sinking the borehole, fitting the pumps, construction and installation of elevated storage tank and electric power is concerned. The borehole is on Administrative Police Post parcel of land which itself,

including the construction of the post was largely a community initiative. The community is expected to partnership actively in the water reticulation phase, which is yet to take off. The borehole is 260m deep with a tested yield of 5 m^3 per hour. The capacity of its elevated tank is 10,000 litres. A ground storage tank of similar capacity has been planned. The community hopes to receive financial support from the CDF kitty to supplement reticulation costs. It is not clear to the community project leaders how the project would operate under the new water reforms structures.

This project was developed around an existing community based group that had been formed (1996) expressly to address the domestic water scarcity in the area.

Borehole under the Athi Water Services Board (AWSB) meant to provide additional domestic water supply to Mugutha residents. A second storage tank is essential to supplement the elevated tank

Plate 5-11 Athi Water Services Board and Community Partnership

Plate 5-12 refers too one of the Boreholes in the process of full development as a result of community initiatives. This borehole is located on community owned land, which also contain a police post at Kimbo.

Plate 5-12 Upcoming Community Based Borehole Water Project

However, the group did not have a proper management structure and its membership was not fully active due to disillusionment arising from the fact that the initiative was taking too long to bear fruits. According to an official involved in the project from its inception, this could partly be attributed to the fact that there existed a private borehole in the neighbourhood and for a long time, the Ruiru GSU base boreholes provided water for free to the local community. However, due to rising cost of maintenance a small humanitarian charge of one shilling per 20 litres container was introduced.

The fact that people had been used to perceive this source of water as a government facility meant to offer water as a "free good", they introduced "politics" in the new arrangements that lead to stoppage of the offer. Talks have been initiated before between the community around the GSU base and the GSU management to look into arrangements and structures under which the community could benefit from the excess capacity of GSU water resources.

b) Mugutha Neighbourhood Self-help Group Water Project

Mugutha Neighborhood Self-help Group Water Project also lays its domestic water problems solutions on ground water source – the former Nyakinyua borehole is one of the oldest with a depth of 76m and a yield of 8 cubic meters per hour. Earlier settled members through a piped network have exploited this borehole but now it is destined to extend to cover over 400 households. The project has been dogged by controversies for a long time, mainly due to the fact that the already connected consumers would not hear of plans to extend the coverage, fearing for possible inadequacy, the fear of loosing control of management and the gains that go with it, if any. But due to rapid settlement that is taking place in the neighbourhood and the fact that there exists no other viable source of domestic water, this expansion is inevitable for now. The Ministry of water district office and the provincial administration has been actively involved in dispute resolution leading to design of an extended supply system. Earlier on, the community had on their own and with the support of Kenya Charity. With the assistance of CDF kitty, the project's proposed reticulation expansion is set to be done, partly though.

As more people settle in this area, the capacity at this borehole could be constrained as more people opt for septic tanks. This neighbourhood is also endowed with two large earth dams such that if provisions are made for drawing water cheaply from these dams for washing and livestock usage, then the pressure on ground water as the only source could be lessened. Rainwater harvesting is not well harnessed as residents whose building roofs are of clay tiles material do not harvest yet they are increasingly becoming the majority. The level of membership involvement here is very high. The maintenance cost of the borehole facility is high as it costs the community about 30,000 for repairs once the pump breaks down. This raises the question of sustainability and technical capacity of the community to manage and operate this borehole.

5.5.6 Private Water Service Providers

Private WSP has been providing domestic water to local residents for a long time. However, because of their few numbers, their services do not meet the level of supply and demand required by the ever-rising population. Their distribution has been inequitable and their supply low in coverage. However, their point of sale (KIOSK) services has provided domestic water to a large number of households in the area despite the high tariffs.

One bore east of Thika road 200m away from the highway has a low yield of $3.3m^3$/hr at a depth of 155m restricting the number of households served to only 50. The reticulation system is supplied through two elevated plastic tanks each with a capacity of $800m^3$; the area covered is about 4 sq km, the coverage being limited due to low supply. According to the owner, the demand is very high especially before the sinking of Murera AP (AWSB's) borehole. The reticulation is done through a 2-inch main and ½ to 1 inches service pipes and all household connections are metered. He records very few bill defaulting. New densification of settlement within the 4 sq km cannot be accommodated. On how the current reforms may affect his services, he observes that public boreholes could be the greatest threat due to envisaged low tariffs.

There exists a few new private boreholes in the study area which if fully operationalised and then commercialised could go a long way to mitigate the domestic water scarcity in the area. The multiplicity of shallow wells and the increased sinking of boreholes is a

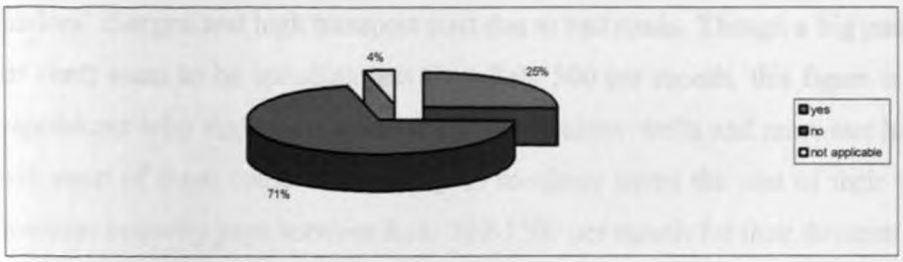
testimony to the fact that ground water is a viable source of water in this dry region of central Kenya. Plate 5-13 shows one of the Private WSP that serve about 50 households with domestic water. The yield of this borehole is about 3.3 cubic meters per hour making it difficult to extend its area of coverage despite its able storage capacity.

Plate 5-13 Private Water Service Providers' Borehole

5.6 Accessibility of Domestic Water

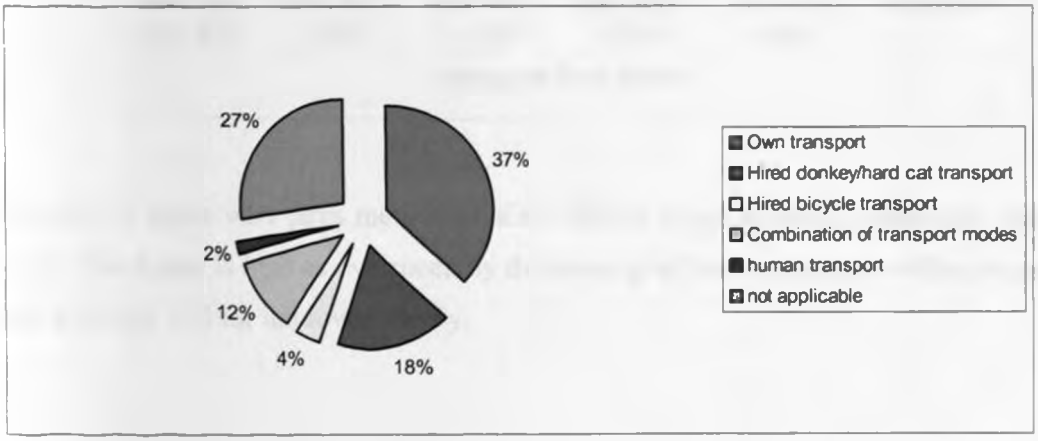
The study found out that majority of households (71 per cent) is not connected to piped water supply. This proportion is higher than the national figure for urban areas in the country. This situation contributes to low piped water coverage and poor equity of distribution in addition to relatively low adequacy levels. The 25 per cent of the households connected are done so from both the ministry of water supply and the reticulated private borehole operators.

Figure 5-11 Whether Domestic Water Supply is piped



For the Non Piped residents of Mugutha Sub-location, the main modes of obtaining water for domestic use were recorded as Own Transport, which accounted for 37 per cent. Here own transport could refer to use of a personal car, personal bicycle, wheelbarrow, or own cart. The 27 per cent not applicable here refer to that section of the population either with piped water or source it water from own shallow well.
Donkey water transport is significant (18 per cent) as compared to hired bicycle transport (4 per cent) due to economy of scale and poor roads conditions.

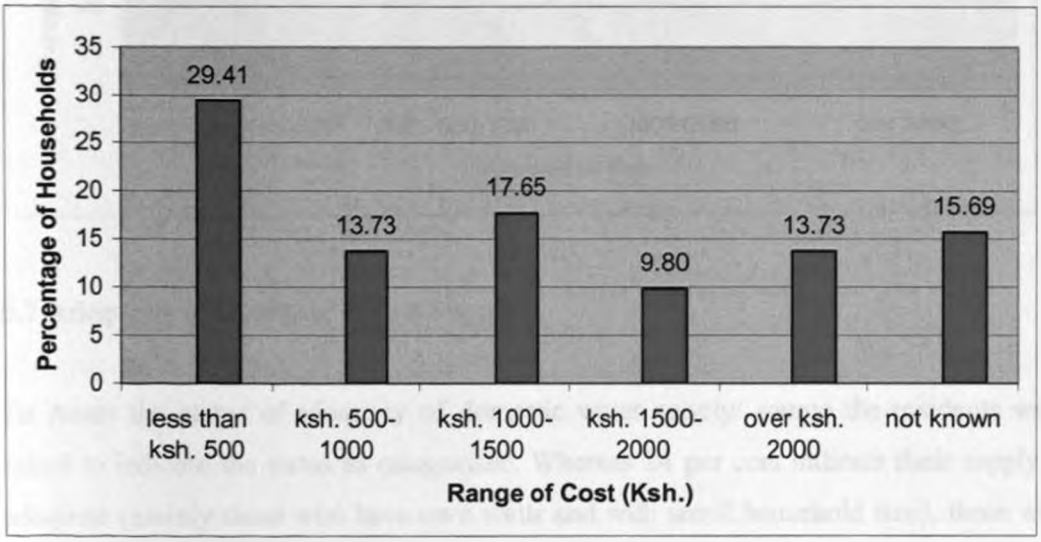
Figure 5-12 Means of Obtaining Non Piped Domestic Water Supply



The frequency of domestic water supply for those households that are connected is rather discouraging as only 38 per cent receive their supplies on daily basis. The rest only receive it between two and four days per week. This kind of unreliability of piped supply demand fairly large capacity storage tanks, which adds a heavy financial burden to most residents in addition to discouraging potential customers.

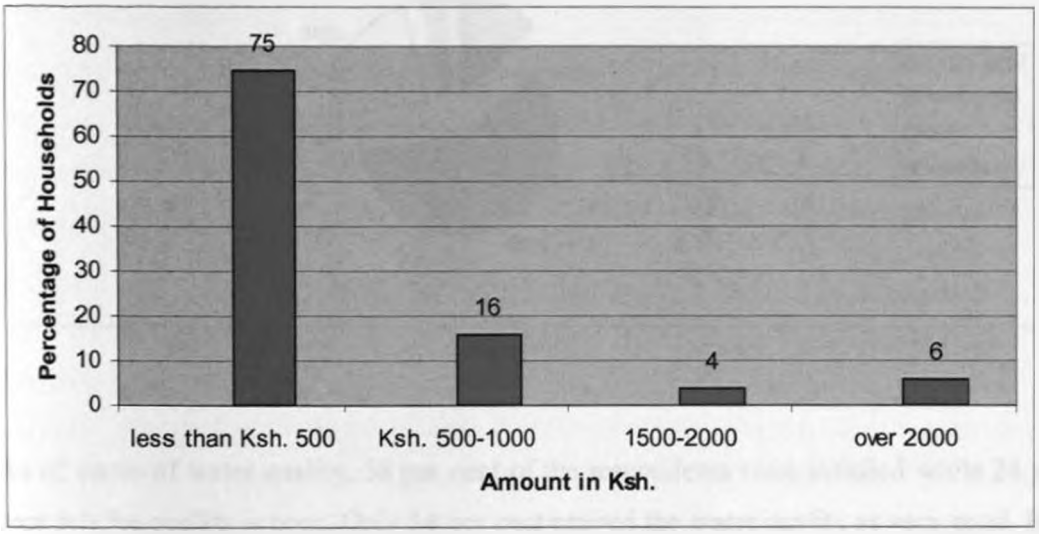
The cost of accessing domestic water in the study area just like most parts of Ruiru municipality is relatively high largely due low ministry's coverage, high private water vendors' charges and high transport cost due to bad roads. Though a big proportion (29.4 per cent) seem to be spending less than Ksh. 500 per month, this figure is distorted by respondents who draw their water from own shallow wells and rainwater harvesting. As such most of them could not quantify in monitory terms the cost of their water source. However majority pays between Ksh. 500-1500 per month for their domestic water.

Figure 5-13 Monthly Cost of Accessing Domestic Water



Majority of those who pays more than Ksh.1500 do keep livestock, especially daily cattle. This figure is high as evidenced by the majority of the respondents willing to pay only less Ksh. 500 for improved supply.

Figure 5-14 Amount of Money Respondents Are Ready To Pay for Improved Domestic Water Supply



5.7 Adequacy of Domestic Water Supply

To Asses the status of adequacy of domestic water supply/ source the residents were asked to indicate the status as categorised. Whereas 24 per cent indicate their supply is adequate (mainly those who have own wells and with small household size), those who depend on ministry's supply and private boreholes give a contrary answer (33 per cent). However, 39 per cent were satisfied with the supply no matter the source.

Figure 5-15 Status of Domestic Water Supply Adequacy

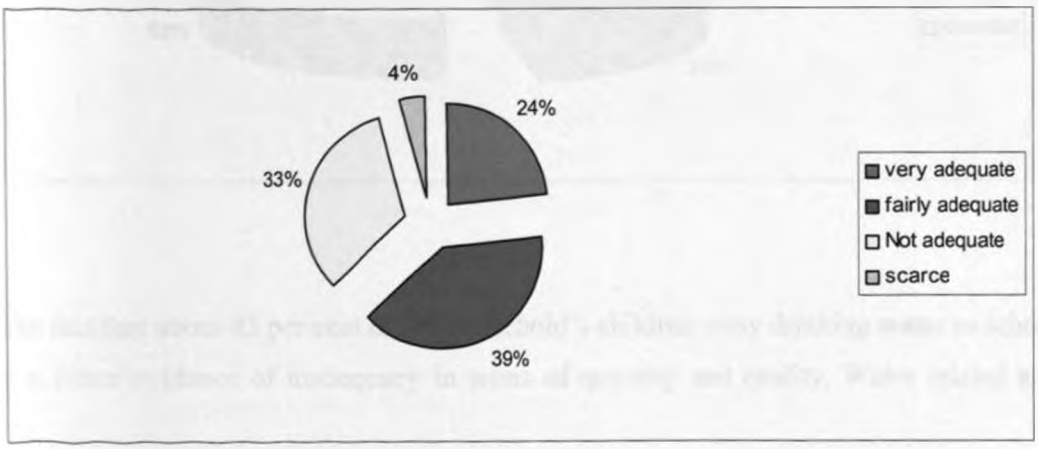
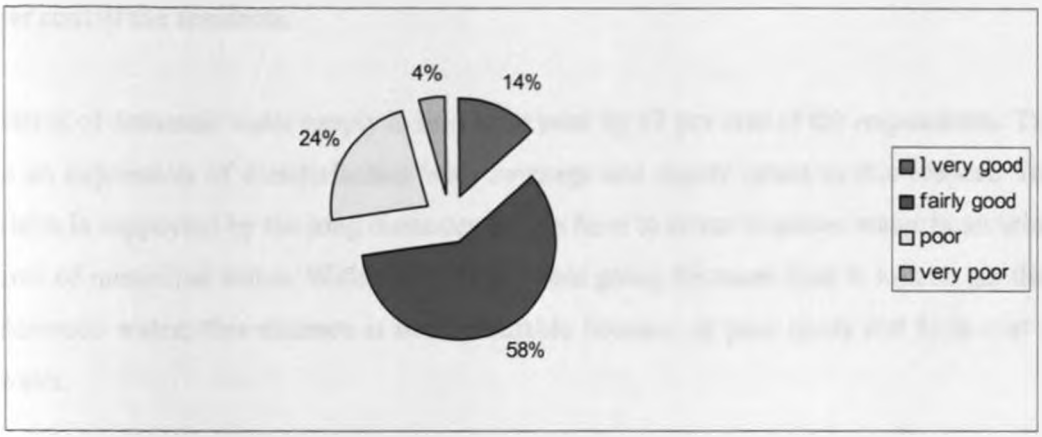
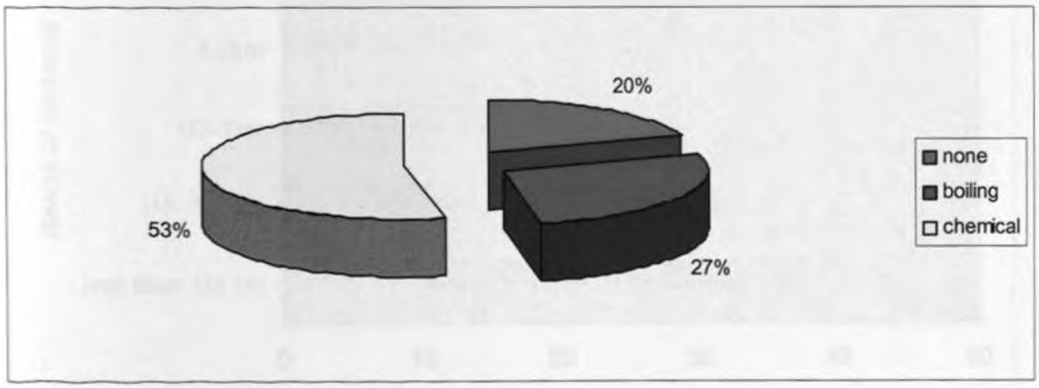


Figure 5-16 Status of Domestic Water Supply Quality



As of status of water quality, 58 per cent of the respondents were satisfied while 24 per cent felt the quality is poor. Only 14 per cent praised the water quality as very good. But the fact that majority (80 per cent) of people treat their water is an indicator that majority do not trust their source especially in respect of the surrounding environment. They therefore apply different forms of treatment mainly chemical (53 per cent) and boiling 20 per cent. This definitely adds to the cost of accessing reliable water supply for domestic use.

Figure 5-17 Type of Domestic Water Treatment



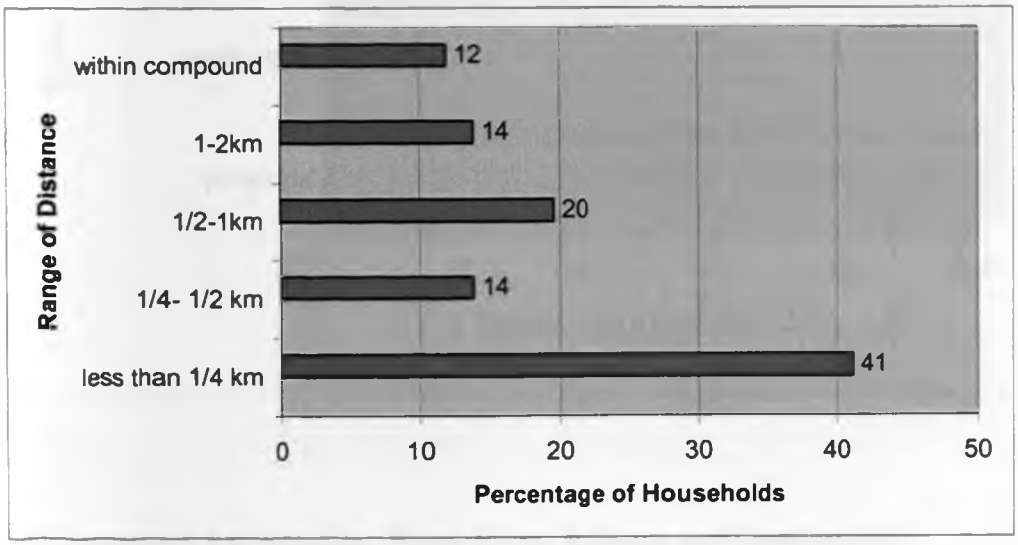
The fact that about 43 per cent of the household's children carry drinking water to school is a father evidence of inadequacy in terms of quantity and quality. Water related and

water borne diseases such as Typhoid, Malaria and Dysentery have been recorded by 51 per cent 0f the residents.

Status of domestic water supply is said to be poor by 57 per cent of the respondents. This is an expression of dissatisfaction with coverage and equity issues in this respect. This claim is supported by the long distances people have to cover to access water in an urban area of municipal status. With about 48 per cent going for more than ¼ km. to get their domestic water, this distance is not favourable because of poor roads and high cost of water.

Due to poor coverage and low level adequacy of water supply and the fact that only a few have access to piped supply, the main mode of excreta disposal at peoples' choice is pit latrines (80 per cent). This situation definitely compromises the sanitation status o f the area as evidenced by the occurrence of water related diseases. The Groundwater resource, though providing a feasible alternative and in most cases the only source of domestic water is under real threat of pollution.

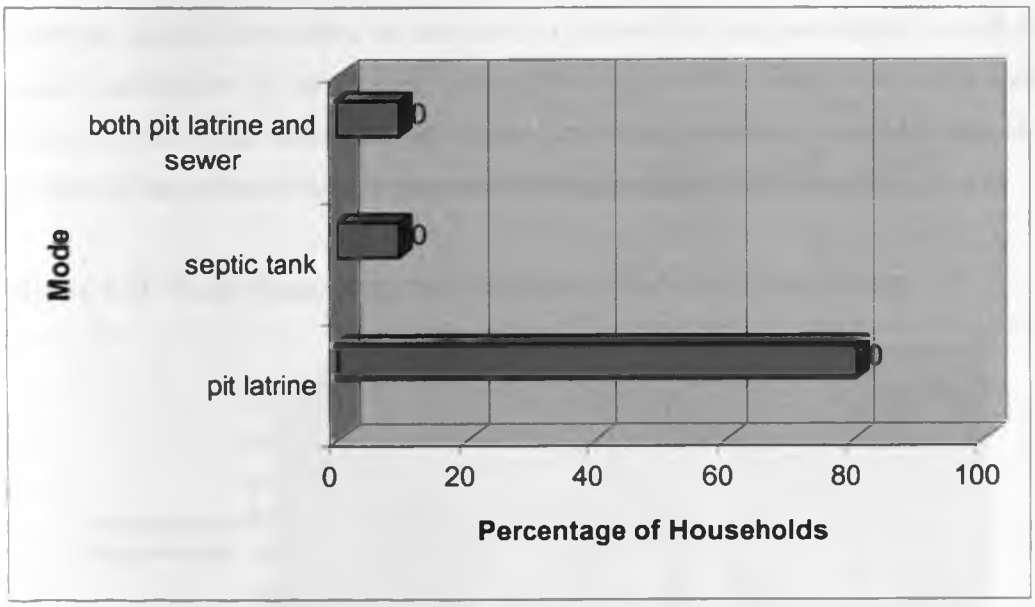
Figure 5-18 Distances to the Nearest Domestic Water Source



5.8 Modes of Excreta Disposal

There exists a close link between domestic water availability and the adopted mode of human wastewater disposal at the household level. In the study area this study established that the main mode of excreta disposal is use of pit latrines. About 80 per cent of the respondents indicate that pit latrine is the only available mode of excreta disposal as adaptation of other alternative modes depends on a reliable supply of piped water. 10 per cent of the residents have both latrines and septic tanks, probably an indicator that the supply is not reliable or maybe they were connected only recently. The connection here refers to either piped water or electric power. Power connection is also changing the mode of excreta disposal as some residents are opting for shallow wells as the alternative source of water in absence of piped water. Consequently, electrical pumps are being installed to pump water to elevated tanks for domestic use including wastewater disposal.

Figure 5-19 Modes of Excreta Disposal

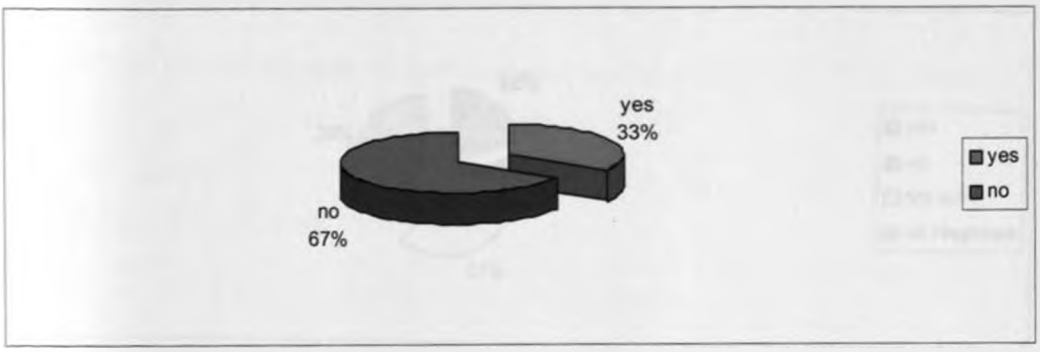


5.9 Community Participation, Water Sector Reforms and Sustainability

The level of community participation in water affairs was surprisingly low as only 33 per cent of household heads were involved in water affairs. May by water affairs are women

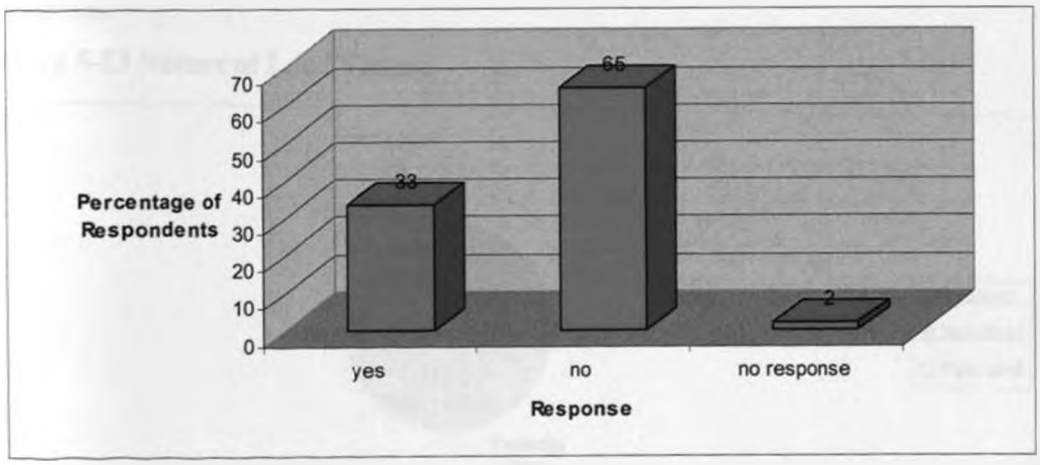
affairs or there is lack of confidence in Community based water projects due to suspicion among community members, or simply a case of waiting for the government to provide a social service.

Figure 5-20 Level of Involvement in Community Water Projects By the Household Head



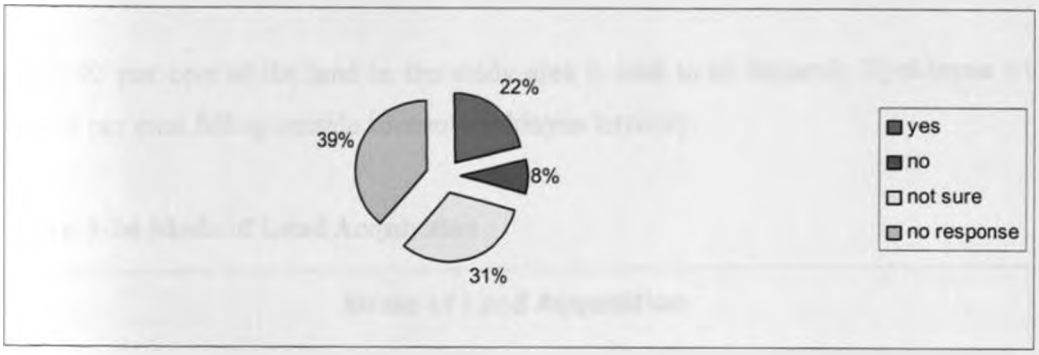
However, lack of awareness on the need to partnership and participation could be a major contribution as only 33 per cent of the respondents were aware of the current reforms in the water sector. Indeed 31 per cent of the respondents were not sure of the impacts of the reforms while 39 per cent could not respond to the question.

Figure 5-21 Water Sector Reforms Awareness Level of the Respondent



Only 22 per cent thought the reforms mean good for the sector with regard to improved services. 8 per cent were categorical that the reforms will not have a positive effect on water service provision.

Figure 5-22 Expectation of Improved Domestic Water Supply on Full Implementation of Water Reforms

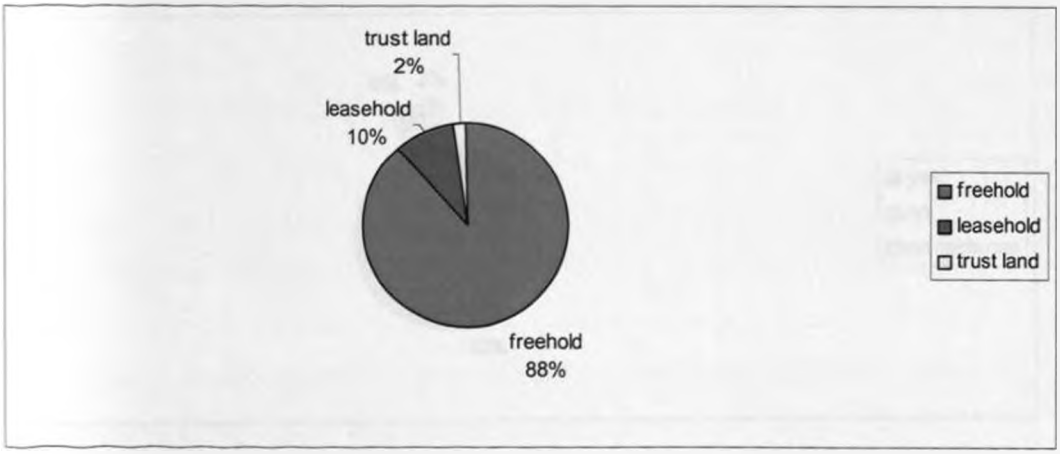


The above scenario brings to the fore the usefulness of education and sensitisation at community level for sustainability of water projects. Both Community Water Projects and Public Water Projects require an informed and active peoples' participation if they were to be sustained in the long run.

5.10 Land Tenure

The land tenure system in an area affects the provision of water and other services. In the study area about 88 per cent of the land was said to be freehold while 10 per cent is leaseholds.

Figure 5-23 Nature of Land Tenure



This status make acquisition of land for public purpose expensive in an area where most of the land originally planned as public land has vanished.

About 76 per cent of the land was acquired through purchase either directly from the original shareholder or from a third party. Land brokerage is a common economic activity in land transactions in the study area.

About 92 per cent of the land in the study area is said to be formerly Nyakinyua with about 6 per cent falling outside former Nyakinyua territory.

Figure 5-24 Mode of Land Acquisition

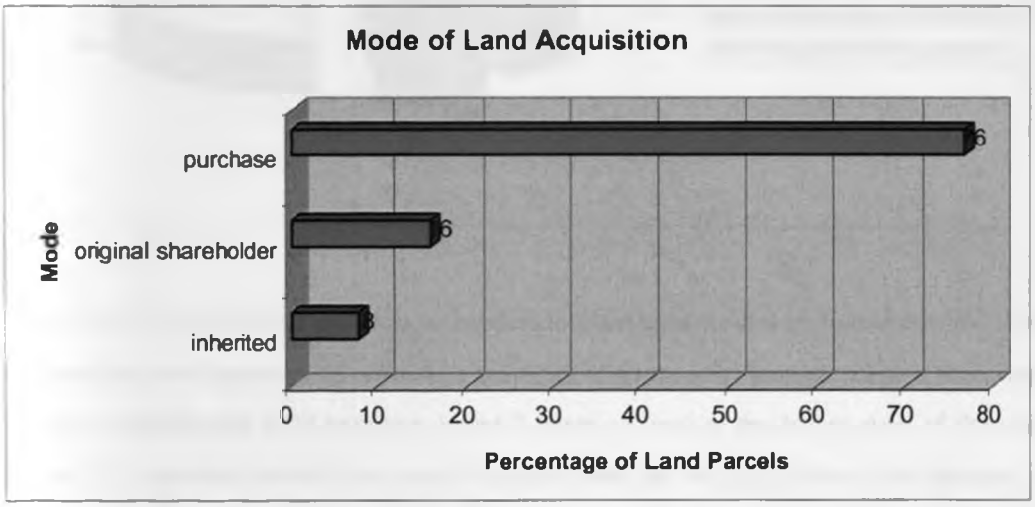
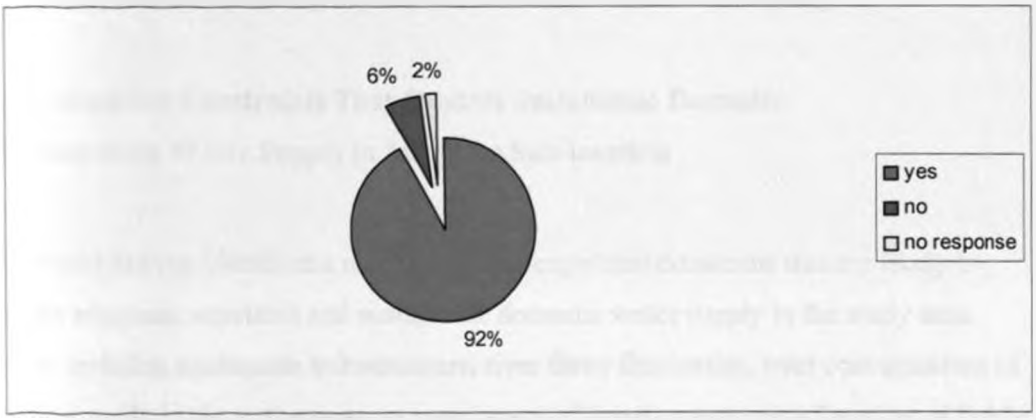


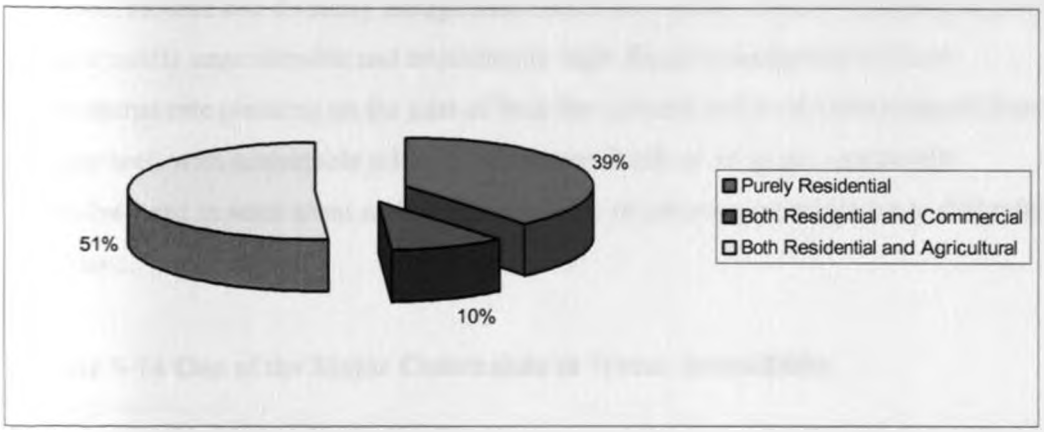
Figure 5-25 Whether Household Land Parcel Was Formerly Nyakinyua



5.11 Land Use Change

The main current land use in the study area stand at 39 per cent pure residential, 51 per cent both residential and agricultural, and about 10 per cent of land use being residential and commercial.

Figure 5-2 4-12 Current Land Use



25 per cent of the respondents plan to subdivide their land further in future while 75 per cent have no such plans as of now. The majority of those who plan to subject their land to further parcellation hold between 1 and 2 acres of land at the lower side of the sub-location. The intended subdivision and change of land use will raise the water demand in the area. In the midst of unplanned subdivision and weak development control the expected upsurge in population will demand additional water sources that require integrated resource planning beyond the boundaries of the municipality.

5.12 Identified Constraints That Hinders Sustainable Domestic Development Water Supply in Mugutha Sub-location

The Field Survey identified a number of challenges and constrains that are likely to hinder adequate, equitable and sustainable domestic water supply in the study area. These includes inadequate infrastructure, river flows fluctuation, over concentration of shallow wells in the settlements, encroachment of riparian reserves, allocation of Public utility land to individuals, wet lands, a valuable part of the ecological system are under

constant threat of human agricultural activities, among others. Ruiru River gauging at water works has not been done for over 10 years now due to faulty equipments making the data inadequate to plot in water flow curve. Lack of Planning and development control is surely bound to negatively affect way leave integrity in the long run. Poor governance has led to grabbing of public utility lands leaving the community with no alternative than to purchase land needed for water projects development. Poor roads and drainage network affects water accessibility as the cost of its acquisition goes up. Uncoordinated and formerly unregulated makes the equity of water distribution poor and water tariffs unpredictable and exorbitantly high. Rapid urbanisation without commensurate planning on the part of both the national and local Governments does not auger well with sustainable urban development. Lack of adequate community involvement in some areas makes sustainability of proposed water projects difficulty to achieve.

Plate 5-14 One of the Major Constraints to Water Accessibility

5.13 Observed Impacts of Commercialisation of Urban Water Supplies

In order to understand how the provision of domestic water would be undertaken in he study are, it is important to briefly scrutinise the vision, operation and challenges of the Athi Water Service Board (AWSB) under whose jurisdiction the study area falls in the new restructured framework of water services commercialisation.

According to the DWE Thika only four (4) WSP are licensed of now in the district. These are:- Gatundu south water and Sanitation company, Juja, Ruiru, Gatanga Trust, Karimeru Water and Sanitation Company in Gatundu North and Thiririka – Ndarugu water supply which the council is taking over. In each of these companies, the Thika County Council, the respective Municipal Council is a major stakeholder. Other partners include representatives from major stakeholders from the community concerned, National chamber of commerce (in case of urban water supply) and representatives of other major water consumers.

As of now only AWSB has been licensed as a management company and no private company such as private borehole owners even if reticulating water has been licensed.

5.13.1 Athi Water Service Board (AWSB)

The AWSB mission is to "ensure the efficient, effective, and sustainable provision of quality and affordable water services in the area of our jurisdiction through appointment of well managed water services providers and development of facilities". In a document entitled "preparedness of NWSB during the Transition period" the CEO of the board presents three broad categories of WSPs as identified by participants of a wide spectrum consultative workshops in late 2004/2005 financial year. These are named as:-Local Authorities - At the time Nairobi, Thika, Machakos and Kiambu who were previously water undertakers had already formed water companies; Clustered water GOK schemes- Assets owned by the GOK/NWC and PC were to be clustered for economy of scale and sustainability of the small schemes) into viable entities which will be managed by autonomous WSPs. The CEO reported that initial analysis indicates that clustering these schemes in each district and ring fencing their assets will be able to meet operational costs; Community based projects- to be encouraged to form WSP (companies). In the

meantime, the boards encouraged them to operate as trusts or CBOs; privately owned companies – the water Act states that WSBs should take over these assets.

5.13.2 Challenges

The imbalance of water infrastructure and coverage in ASAL areas of Machakos, Kajiado and Makueni and parts of Thika and Kiambu has been noted. The high level of poverty where over 50 per cent of the population live – poor urban settlements and low potential areas, posses a great challenge to water and sewerage provision in the area under the board's jurisdiction. Another noted challenge is the failure of GOK institutions to play for WSS to the WSPs. As such the board has inherited huge unpaid bills. NAWASco, for example is owed over one billion in this respect. Though the water sector was liberalised in an effort to enhance service delivery, residents in major towns are still faced with water shortages from time to time. The Kisumu water and Sewerage Company (KIWASCO) and the Nairobi Water and Sewerage Company (NAWASCO) were formed in 2002 and 2004 respectively as required after the enactment of the Water Act 2002(Allan, Kisia-WWD-2006) For NAWASCO, one of the greatest challenge has been billing problems which its is tackling by opening more braches in the city. It has also partnered with the Co-operative Bank, post office, and K-Rep Bank to give customers a wide range of pay points centres nearer to them.

Although some of the objectives of KIWASCO have been meet, the Lakeside city still faces problems of inadequate water infrastructure to cater for the rising population. As such, about half of more than 800,000 residents have no access to tap water because the demand of 45,000 cubic metres a day has outstripped the supply of 18,500 cubic metres (Allan, Kisia-WWD-2006). Illegal water connection, corruption among metre readers and water leakages are still a major challenge in Nairobi and Kisumu, and indeed in all other major towns.

Despite some of the problems encountered in the commercialisation process, some of the positive results so far recorded include:

1. The management of Water Services Companies has been much more autonomous than those in corporate or direct public utilities

2. The enhanced cost recovery and operational performance of WSCs due to improved professionalism

3. Local Authorities unlike pure private companies are not profit driven thus promoting equity

5.13.3 Strengths

Strengths that have been noted within the board's area of jurisdiction includes: - the competence of Government of Kenya officers; The elaborate infrastructure, especially in the high potential areas of Kiambu, Thika and Nairobi where coverage of water includes areas run by community and self help groups, municipalities, privately developed boreholes and Government of Kenya schemes which enhance water provision; the existence of a clear legal framework guiding water sector reforms clearly delineating the responsibilities of the newly created water sector institutions. The board is also 80 per cent operational in terms of human resource and equipment with an elaborate governance structure, which includes formation of board committees e.g. Finance, technical, tender, audit, and staff and welfare. The AWSB also enjoys a high yield water resource base of a well spread network of rivers and high potential underground aquifers.

Observed is also a high level of political goodwill and support from the development partners in the expansion of water services and reform process. However, challenges exist that will have to be surmounted if improved water services is to be realised in an efficient and cost effective manner for sustainability. These challenges includes: - Limited financial resources for immediate rehabilitation and augmentation of WSS infrastructure, transformation of Government of Kenya, Municipal and Community Based Organisations employees into effective and efficient demand of an enlightened customer base; building of consensus among actors on common strategies of reforms implementation; possibilities of industrial unrest in the transfer of staff and liabilities to the board unless appropriate strategies are developed to guide the process.

An opportunity that exists includes the people's willingness to participate in the management of water affairs, the willingness of private sector to invest in the water services and the high un-served population willing to pay for services.

CHAPTER SIX

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

6.1 Summary of Findings

This section outlines a summary of the case study findings. The findings provides the bases of proposing recommendations that may mitigate the identified constraints in a view to promote and enhance adequacy, equitability and sustainability of domestic water development and provision within the framework of Integrated Resource Planning and management.

6.1.2 Baseline Information

Majority of households were male headed (71 per cent) and the average household size was 4. Majority of the household heads had post secondary education in that 23.5 per cent had University education, a similar percentage had college education, and 35.3 per cent had secondary education while 15.7 per cent had attained primary education level. Only 2 per cent had no formal education status. These statistics indicate that majority of the study area members are well educated and possibly exposed to understand and express their needs, desires, and frustrations coherently to those who care to listen and act. This level of literacy enhances the issue of sustainability just as much as policy and planning process are likely to gain from such a community.

6.1.3 Housing and Infrastructure

About 86.3 per cent of respondents' houses were permanent in nature while (5.9 per cent) were temporary and 7.8 per cent semi-permanent. The housing class range from low to medium to high-class palatial homes. Despite the presence of these permanent classes of houses, commensurate classes of infrastructure such as good roads and pipe water are lacking.

6.1.4 Place of Work and Main Modes of Transport

Over 40 per cent of the respondents work in Nairobi. The main mode of transport used by the household heads to their place of work is Matatu (49 per cent), Personal cars (15.7 per cent), Cycling (5.9 per cent) and Walking (9.8 per cent). The study noted that Bicycle / Boda Boda is an important mode of transport to work, to school and to access other vital services. This mode however is greatly limited by poor road condition and insecurity in the area. These kinds of roads are common in Mugutha making accessibility of domestic water and other vital services not only difficult but also exorbitant.

6.1.5 The Role of Urban Agriculture

The peri-urban area of Mugutha sub-location is largely rural in nature with limited commercial and industrial activities. Due to relatively large land parcels, ranging from ¼ acres to 2 acres and good soils especially in the former coffee zones, majority at households (52 per cent) engage in some form of urban agriculture. Urban agriculture is popular in Mugutha as a variable source of food and a source of income too. To others it is a hobby. A few households (33.5 per cent) keep some cattle of which 13.7 per cent have 1-3 No. Cattle while 2 per cent have over 10 cattle. The urban agriculture activities support agro-chemical based business in Ruiru and other commercial outlets all over the municipality. The sub-sector is also a major employer and definitely a reliable source of extra income. Certainly, these urban agricultural activities impact on water demand at household level as shown in water demand computations. On the other hand, a significant number of those already rearing cattle would eventually replace them with commercial land uses due to rising demand for land for either rental housing or normal residential housing, a pointer to eventual subdivision.

6.1.6 Sources of Domestic Water Supply

Mugutha Sub-location, just like the rest of the Municipality regions receive it water for domestic use from both surface and ground water sources. Precipitation is also an important source of domestic water especially during the rains.

6.1.6.1 Public Water Supply

Ruiru Water Works

Ruiru Water Works has a treatment plant that is composed of two sedimentation tasks of $45m^3$ capacity each and one composite unit with a capacity of $60m^3$.The treatment works discharges between 650 and $800m^3$ per day of treated water at a rate of $35m^3$ per hour. The raw water which is of varying quality through the year undergo the normal treatment process of sedimentation, coagulation and flocculation and chlorination before being pumped to a single elevated tank for onward distribution. The level of treatment varies with the amount of turbidity and raw water pollution depending on the season and industrial and agricultural activities upstream. Occasionally, industrial discharges (untreated) affect the raw water quality and hence the level and cost of treatment of water for domestic use.

Treated water is distributed to residential, commercial and industrial users in a rationed manner as the demand far outstrips the supply. The local water offices estimates a daily water demand have about $10,000m^3$ against a daily supply of about $725m^3$ on average. Thus the supply is less than 10 per cent of the total demand for the entire municipality. This estimated demand does not include areas being served by the Nairobi Water and Sewerage Company. The total extent of coverage is about $4.5km^2$ though the network is yet to be densified . It is important to note that the supply to industrial establishment is far from their demand. According to the Ministry of Water, Ruiru Water Works supplies water as follows: 15 per cent residential users, 15 per cent, 30 per cent commercial and 40 per cent industrial.

6.1.6.2 Institutional Water supply

a) Ruiru General Service Unit Water Works

Ruiru GSU Water Works draws its water from Ruiru River upstream. The intake is about 1.8km from the GSU base and has three powerful electrical pumps of 50HP each, which operate one at a time. This fills the $500m^3$ capacity raw water tanks in 31/2 hours. On treatment, three pumps each of 20 horsepower pumps clean water to elevated tank, one

operating at a time. The elevated tanks and the clear water ground facilities can store adequate water for 3 days as the daily demand ranges between 150-180m^3 against a daily supply of 500m^3. The resident population is about 400 at any one time. Ruiru G.S.U Water Treatment Works has a much more capacity than the current G.S.U population needs. The facility could be utilized to mitigate water shortage in the neighboring community

b) The Kenyatta University Ruiru Campus Water Supply

The Kenyatta University Ruiru Campus with two boreholes of 84m and 110m deep respectively still has to supplement its supply from AWSB. With a population of about 1,400 on average, the Ministry of Water Supply to this campus is far from adequate especially in absence of borehole water during power blackouts and bore repairs.
The ministry's tariff structure is such that for domestic use 10m^3 per month is charged (10,000 litres) a flat rate of Ksh. 200. From 10-20$m,^3$ Ksh. 25 are charged for 1m^3 of excess and this rises to Ksh. 30 for every 1m^3 of excess water.

6.1.6.3 Community Based Water Supply

a) Murera Borehole Water Project

Murera Borehole was sunk by NWC&P on behalf of the Athi Water Services Board early 2006. The borehole is on Administrative Police Post parcel of land which itself, including the construction of the post was largely a community initiative. The community is expected to partnership actively in the water reticulation phase, which is yet to take off. The borehole is 260m deep with a tested yield of 5 m^3 per hour. The capacity of its elevated tank is 10,000 litres. A ground storage tank of similar capacity has been planned. The community hopes to receive financial support from the CDF kitty to supplement reticulation costs. It is not clear to the community project leaders how the project would operate under the new water reforms structures. This project was developed around an existing community based group that had been formed (1996) expressly to address the domestic water scarcity in the area.

b) Mugutha Neighbourhood Self-help Group

Mugutha Neighbourhood Self-help Group lays its domestic water problems solutions on ground water source – the former Nyakinyua borehole is one of the oldest with a depth of 76m and a yield of 8 cubic meters per hour. Earlier settled members through a piped network have exploited this borehole but now it is destined to extend to cover over 400 households. As more people settle in this area, the capacity at this borehole could be constrained as more people opt for septic tanks. This neighbourhood is also endowed with two large earth dams such that if provisions are made for drawing water cheaply from these dams for washing and livestock usage, then the pressure on ground water as the only source could be lessened.

6.1.6.4 Private Water Service Providers

Private WSP has been providing domestic water to local residents for a long time. However, because of their few numbers, their services do not meet the level of supply and demand required by the ever-rising population. Their distribution has been inequitable and their supply low in coverage. However, their point of sale (kiosk) services has provided domestic water to a large number of households in the area despite the high tariffs. There exists a few new private boreholes in the study area which if fully operationalised and then commercialised could go a long way to mitigate the domestic water scarcity in the area. The multiplicity of shallow wells and the increased sinking of boreholes is a testimony to the fact that ground water is a viable source of water in this dry region of central Kenya.

6.1.7 Adequacy, Quality and Accessibility of Domestic Water Supply

The study found out that majority of households (71 per cent) is not connected to piped water supply. This proportion is higher than the national figure for urban areas in the country. This situation contributes to low piped water coverage and poor equity of distribution in addition to relatively low adequacy levels. The 25 per cent of the households connected are done so from both the ministry of water supply and the reticulated private borehole operators.

The frequency of domestic water supply for those households that are connected is rather discouraging as only 38 per cent receive their supplies on daily basis. The rest only receive it between two and four days per week. This kind of unreliability of piped supply demand fairly large capacity storage tanks, which adds a heavy financial burden to most residents in addition to discouraging potential customers. The cost of accessing domestic water in the study area just like most parts of Ruiru municipality is relatively high largely due low ministry's coverage, high private water vendors' charges and high transport cost due to bad roads.

Whereas 24 per cent indicate their supply is adequate (mainly those who have own wells and with small household size), those who depend on ministry's supply and private boreholes give a contrary answer (33 per cent). However, 39 per cent were satisfied with the supply no matter the source. As of status of water quality, 58 per cent of the respondents were satisfied while 24 per cent felt the quality is poor. Only 14 per cent praised the water quality as very good. But the fact that majority (80 per cent) of people treat their water is an indicator that majority do not trust their source especially in respect of the surrounding environment. They therefore apply different forms of treatment mainly chemical (53 per cent) and boiling 20 per cent. This definitely adds to the cost of accessing reliable water supply for domestic use. The fact that about 43 per cent of the household's children carry drinking water to school is a father evidence of inadequacy in terms of quantity and quality. Water related and water borne diseases such as Typhoid, Malaria and Dysentery have been recorded by 51 per cent 0f the residents. Status of domestic water supply is said to be poor by 57 per cent of the respondents.

This is an expression of dissatisfaction with coverage and equity issues in this respect. This claim is supported by the long distances people have to cover to access water in an urban area of municipal status. With about 48 per cent going for more than ¼ km. to get their domestic water, this distance is not favourable because of poor roads and high cost of water. Due to poor coverage and low level adequacy of water supply and the fact that only a few have access to piped supply, the main mode of excreta disposal at peoples' choice is pit latrines (80 per cent). This situation definitely compromises the sanitation status o f the area as evidenced by the occurrence of water related diseases. The

Groundwater resource, though providing a feasible alternative and in most cases the only source of domestic water is under real threat of pollution.

6.1.8 Water Availability and Means of Excreta Disposal

In the study area this study established that the main mode of excreta disposal is use of pit latrines. About 80 per cent of the respondents indicate that pit latrine is the only available mode of excreta disposal as adaptation of other alternative modes depends on a reliable supply of piped water. 10 per cent of the residents have both latrines and septic tanks, probably an indicator that the supply is not reliable or maybe they were connected only recently. The connection here refers to either piped water or electric power. Power connection is also changing the mode of excreta disposal as some residents are opting for shallow wells as the alternative source of water in absence of piped water. Consequently, electrical pumps are being installed to pump water to elevated tanks for domestic use including wastewater disposal.

6.1.9 Sensitisation and Community Participation

The level of community participation in water affairs was surprisingly low as only 33 per cent of household heads were involved in water affairs. However, lack of awareness on the need to partnership and participation could be a major contribution as only 33 per cent of the respondents were aware of the current reforms in the water sector. Indeed 31 per cent of the respondents were not sure of the impacts of the reforms while 39 per cent could not respond to the question. Only 22 per cent thought the reforms mean good for the sector with regard to improved services. 8 per cent were categorical that the reforms will not have a positive effect on water service provision. The above scenario brings to the fore the usefulness of education and sensitisation at community level for sustainability of water projects. Both Community Water Projects and Public Water Projects require an informed and active peoples' participation if they were to be sustained in the long run.

6.1.10 Land Tenure and Use

The land tenure system in an area affects the provision of water and other services. In the study area about 88 per cent of the land was said to be freehold while 10 per cent is leaseholds. This status make acquisition of land for public purpose expensive in an area where most of the land originally planned as public land has vanished. About 76 per cent of the land was acquired through purchase either directly from the original shareholder or from a third party. Land brokerage is a common economic activity in land transactions in the study area. About 92 per cent of the land in the study area is said to be formerly Nyakinyua with about 6 per cent falling outside former Nyakinyua territory.

The main current land use in the study area stand at 39 per cent pure residential, 51 per cent both residential and agricultural, and about 10 per cent of land use being residential and commercial. 25 per cent of the respondents plan to subdivide their land further in future while 75 per cent have no such plans as of now. The majority of those who plan to subject their land to further parcellation hold between 1 and 2 acres of land at the lower side of the sub-location. The intended subdivision and change of land use will raise the water demand in the area. In the midst of unplanned subdivision and weak development control the expected upsurge in population will demand additional water sources that require integrated resource planning beyond the boundaries of the municipality.

6.1.11 Constraints to Sustainable Development, Provision and Management of Domestic Water

The Field Survey identified a number of challenges and constrains that are likely to hinder adequate, equitable and sustainable domestic water supply in the study area. These includes inadequate infrastructure; River flows fluctuation; over concentration of shallow wells in the settlements, Encroachment of riparian reserves; allocation of Public utility land to individuals, wetlands threatened.

Lack of Planning and development control is surely bound to negatively affect way leave integrity in the long run. Poor governance has led to grabbing of public utility lands leaving the community with no alternative than to purchase land needed for water projects development. Poor roads and drainage network affects water accessibility as the

cost of its acquisition goes up. Uncoordinated and formerly unregulated makes the equity of water distribution poor and water tariffs unpredictable and exorbitantly high. Rapid urbanisation without commensurate planning on the part of both the national and local Governments does not auger well with sustainable urban development. Lack of adequate community involvement in some areas makes sustainability of proposed water projects difficulty to achieve.

6.2 Recommendations

Whereas an expansion of water use is necessary to ensure the existence of a population that continues to grow rapidly, It must not be allowed to threaten the long-term availability of water resources in the municipality and areas downstream. Water supply planning has therefore to ensure the sustainability level of dry season discharge of both the surface water sources such as the Ruiru and Theta rivers and the ground water aquifers in the Athi Basin. In addition, water supply development must not lead to concentration of land use and changes in use that endanger further natural resources.

Planning for water supply development must ensure that the supply situation can be improved first for those segments of the population suffering most from a shortage of domestic water supply. The requirement for prioritisation according to needs becomes even more important in a development context where funds for the implementation of supply systems are very limited, and even tend to shrink on a per capita basis due to increasing population and stagnating support from the Government and development agencies.

For efficient and cost-effective domestic water supply to urban population, factors of sources of water, quantity and quality, technology of water, water treatment and distribution, operation ad maintenance, institutional and legal arrangements and public or community involvement have to be addressed in an integrated manner for sustainability. Prudent water demand management is an essential aspect in this respect.

6.2.1 Promoting Accessibility and Sustainability of Domestic Water

Although the balancing of sustainable water use and development of need–oriented supply are the key requirements of water development planning in Ruiru, the water supply systems proposed by the planning process must be technically and financially viable for long-term sustainability. This need is made emphatic by the fact that while about 42 per cent of the respondents declare that the status of adequacy of their domestic water supply is either scarce or inadequate more than 70 per cent are not willing to pay more than Ksh. 500 per month for a more reliable domestic water supply. Proposed domestic water supply planning should take into consideration the dynamics of social-economic and land use transformation and allow for dynamic modifications and incremental coverage expansion. The adaptations to changing supply needs should be made possible without endangering the requirements of integrated resource planning of long-term sustainable use over water resources. Due to rising water demand and the low yield of some of the sunk boreholes, there is need to sink more in hydro geologically favourable areas even if this means change of user if such a site happen to be private land as is the most likely case.

6.2.2 Equity Enhancement

With commercialisation it is possible that the cost of acquiring piped domestic water supply could be beyond the affordability of the poor members of Mugutha society. As such a progressive system of connection charges may be used in the same way as a progressive tariff system to make the richer consumers cross-subsidize the poorer ones and to cover the cost of extension to the network.

The AWSB should move with hast to facilitate the licensing of both public and private WSPs so as to enable expansion of water distribution. It should also determine clear criteria for prioritising future expansion areas, increase competition by enabling/establishing additional sources of water in order to put downward pressure on prices and upward pressure on service quality. Water on-sellers are important sources of water and many urban poor rely on them for the domestic water needs. They offer such advantages as flexible 'pay as you go' system which is often more manageable than

monthly bills. However, Water on-sellers draw their water from a variety of sources making quality determination and regulation difficult to ascertain. The AWSB could establish fair and consistent price and quality control for vendors.

The WSPs should consider selling bulk water to vendors at rates that reflect the reduced cost to the utility of distributing water through them. These moves will subsequently enhance equity of water provision in the area.

6.2.3 Institutional and Legal Framework

Sustainable domestic water supply demand a well thought out institutional and legal framework that allocates specific authority and responsibility for each phase of water planning, development and management and for each stakeholder involved. Clear and practical mandates need to be assigned to legally established water sector bodies and a co-ordinating mechanism provided for harmony and efficiency. These arrangements definitely call for comprehensive complementing policies that guide the entire water sector. The Provisions of the Water Act 2002 and the National Water and Sanitation Strategy should be applied in a systematic and humane manner taking into consideration the needs of the poor segment of society. The WSPs should operate within this legal and institutional framework for harmony and consistency in water service provision.

6.2.4 Community Water Projects

Self help or community based water projects reduces burden on the central and local governments since the local community is actively involved in the provision of human, financial and technical resources in form of ideas, cash, labour, materials, and time. This level of involvement promotes sustainability in all its facets of water supplies, however, the role of the governments in providing the necessary guidance and support cannot be ignored. Policy and technical guidance and support from both the central and local government are an important cog in the wheels of water resources preservation, conservation and development.

6.2.5 Public Participation and Community Involvement

The success of water supply programme depends on the extent to which society is considered during the planning stages. From an administrative point of view, community participation leads to greater efficiency since all beneficiaries are willing to be involved in all aspects of the project. Genuine and unfailing involvement of the community right from the initial stages, through planning and design to implementation, operation and maintenance ensures water supply systems success.

Community based water projects should continue to operate and be supported by the board through capacity building and expansion programmes. The communities ought to be trained on issues of governance, financial management, operations and maintenance, development of business plans; etc, all aimed at making them sustainable and eventually be appointed as stand alone water service providers.

In order to ensure adequacy of supply, the community based water supply schemes will have to invest in additional storage tanks both at the borehole sites and along the distribution networks. Control of water usage to guide against usage of water meant for domestic purposes being used for irrigation purpose due to common urban agriculture practices in an area where rainfall is low and inevitable. Mechanisms to provide this control include: metering the supply and applying staged billing system so as to charge exorbitantly high for extra supply beyond the normal domestic allocation per month; Use of kiosk system instead of household connections in areas where even the cost of metering is high for majority of community residents; Clear-cut rules and regulations drawn by the community members and registered, as part of a constitution. Any opportunity for external assistance should be exploited transparently and funds and materials and equipments arising from such offer ought to be utilized prudently and timely for intended purposes.

6.2.5.1 The Role of Sensitisation and Education

Experience from across the globe and Africa in particular shows that the best designed water pipeline can be vandalized or misused while some of the purest and most adequate

supplies have been abandoned in favour of impure, indigenous supplies lack of community involvement, awareness and altitude contribute to this undesirable occurrences. Inequitable distribution of domestic water supply could lead to a section of the community feeling that they have been left out unfairly from the distribution network and this could result to sabotage and vandalism.

From the study it is evident that there is need to roll out a communication programme on the water reforms to the grassroots with the aim of changing the consumers from passive receipt of services to be active participants in the planning, development, and management of the water affairs. Education and awareness creation could lead to better understanding of the need to use water more economically, the need to store water, the purpose and justification of water rationing, and the importance of reporting water leakage, illegal connections and vandalism.

6.2.5.2 Quality Water Supply Systems

Urban water quality is perceived from source of the water, effectiveness of the disinfections techniques and available technologies for water treatment. Most urban water supplies provide poor quality water due to ineffective filtration methods. The AWSB should ensure, as a matter of policy, that all AWSPs supply domestic water of good quality to consumers all the time. The consumers too could be sensitised on the need to apply good sanitary practices during water storage. This must be done to militate against occurrence of water borne and water related diseases.

6.2.5.3 Appropriate Technology

The development of water technology and technical packages must consider aspects of appropriateness and cost of such technology to allow for modification and flexibility to suit local situation. The type and level of technology adopted definitely impact on sustainability of domestic water supply in the long run. The technology appropriate for urban water supply in must be chosen in such a way as to make it easily understandable by its operators and easy to operate and repair without too much technical knowledge or

need for imported materials. Therefore WSPs should opt for appropriate water technology, which promotes financial and technical sustainability.

6.2.5.4 Operation and Maintenance

Operational problems are normally caused by lack of sufficient and cost effective O& M practices; lack of adequate allocation of funds for O & M and incompetent personnel has resulted in partial or complete failure of many domestic water projects in third world countries. All WSPs should as a matter of priority plan for funding of O & M including personnel training for sustainability of water projects. The consumers of water resources and service must contribute for O& M both in the short and long term basis. The perception that water is a social good and not an economic good can no longer hold for long and need to be changed through education.

6.2.6 Water Demand Management

To balance the demand and supply of water, a number of proposals have been suggested in the past including reduction or control of population growth, adoption of appropriate technology, regular review of water and water related policies, mobilization of resources for sustainability and the incorporation of environmental assessment in all development activities that affect water resources. The demand on a water supply may be reduced without a fall in the standard of service by the following methods:

6.2.6.1 Leakage Reduction

Leaky distribution mains are of particular concern with intermittent supplies and where there are low pressures as pollution from drains and sewers may enter through the leaks when the pressure drops. Repair of leaking mains is made more difficult by the lack of accurate records showing pipe routes.

6.2.6.2 Tariff Policy

Simply introducing water meters to houses with private connection can lead to substantial reductions in water demand. If water is priced correctly, then consumers will seek and find ways to use water efficiently.

6.2.6.3 Water-Saving Taps and Fittings

Devices are now available which can be installed in line on private connections or on individual taps, which restrict flow to a fixed amount irrespective of the pressure in the mains. These are simple to manufacture cheap and easy to install. Special shower nozzles and spray taps for sinks are increasingly used and can give the same washing efficiency with less than a quarter of the flow of water from conventional fittings. Others water saving measures includes installation of security meters- a prepayment meter that allows the consumer to have control over water use.

6.2.6. 4 Consumer Education and Information

Publicity campaigns to reduce water wastage and unnecessary consumption have been successful in a number of developed countries and it is likely that if socio-cultural preferences were taken into account similar campaigns would prove equally effective in developing countries. Information on water supply systems could advantageously be coupled with health education aimed at schools factories and clinics focusing on the interrelation between health water and excreta and sewage disposal. Informative billing system used in South Africa is such a strategy. People are willing to co-operate if they get regular feed backs as to the impacts of their own actions.

6.3 Conclusion

The management of water resources and services in Kenya was, and for most part continues to be based in the separate sectoral administration of the different uses of the resource. Going by the National Development Plans, Urban Water Supply has received

inadequate attention from the central government, which has over the years emphasized more on rural water supplies to the detriment of fast urbanizing municipal areas. Rapid population growth and urbanization processes presents challenges that demand innovative and pragmatic solutions to water services and sanitation services delivery problems. Despite previously suggested mitigations, urban water demand has always outstripped water supply in urban areas leading to conflict, ill health, and environmental degradation and declining economic performances. Ultimately the social- economic well being of urban majority is affected adversely and poverty lingers on endlessly.

The government new water sector policy of decentralization and commercialization of both water and sanitation services places tremendous challenges on local authorities in there bide to provide these essential services. Ruiru municipal authority is particularly challenged due to its vastness, fast urbanization, it dwindling economic base and weak or non-existing institutions among other factors. Both the national Government and local Government programmes have so far failed to address these challenges in a sustainable manner to the detriment of the standard of residents' living and environmental sustainability. In the backdrop of these myriad shortcomings, prudent planning, development and management of water and sanitation infrastructure in general and domestic water in particular become an inevitable to any proposed developmental agenda of the municipality.

The municipality of Ruiru faces a number of significant challenges in relation to domestic water provision. Key among these challenges is the effect of rapid urbanization in the face of constrained municipal capacity to fully embrace the reforms in the water sector. Due to ever increasing population pressure in the City of Nairobi and hence enormous strain on basic infrastructure and services. Ruiru municipal authority is not a Water Service Provider and as such does not provide water borne sewerage services to the municipal residents that includes Mugutha residents. This scenario aggravates the water supply and sanitation situation in the expansive, fast growing municipality. The nature and pattern of human settlement and subsequent socio economic activities in Mugutha sub-location make the provision of adequate water and sanitation services a big challenge.

Data collected on Mugutha sub-location and analysed based on Integrated Resource planning framework has shown there is lack of equity considerations in domestic water supply in the study area. It has also demonstrated that the level of supply of domestic water is far below water demand despite the existence of several sources of water for domestic use. Lack of or inadequate coordination and stakeholders' involvement in domestic water affairs contributes to a significant degree to inefficiency and non-equitability of water supply in Mugutha. The impact of urban agriculture on domestic water demand has been analysed partly in the study just as the role of community water projects in the study area.

Rampant use of pit latrines and shallow wells in Mugutha poses health and environmental hazards in an area where storm water drainage literally does not exist. As such majority of the residents in the study area must treat their water before drinking. Other noted challenges in the study area include: inappropriate solid waste management and wastewater disposal mechanism; insufficient physical planning; and inadequate development control. This situation has lead to general environmental decay and poor health standards in the study area. Lack of adequate financial, human and technical capacity and weak institutional arrangements on the part of the municipal authority has resulted to poor water service delivery. This situation is likely to worsen unless the prudent mitigating measures are not put in place so as to address the identified constraints. Thus the recommendations made in this study, if implemented, could go along way in easing the inequity and inadequacy of domestic water supply in Mugutha sub-location in particular and Ruiru municipality in general.

6.4 Areas for Further Study

Since time and resources limited the scope of this study, the bigger picture of water situation in Ruiru could not be obtained. Consequently the holistic principle of Integrated Resource Planning and its benefits could not be realised. Further studies are recommended in the following areas:

1. The impact of Urban Agriculture on Water Demand in the Entire Ruiru Municipality.

2. The Impact of Pit Latrines as a Mode of Excreta Disposal on Groundwater Quality in Ruiru Municipality

3. Planning and Design of An Integrated All Water Service Providers' Reticulation Network as a Bases of Implementing a Sustainable Municipal Sewerage System

4. The Possibilities of Enhancing Flood Water as a Source of Domestic and Irrigation Water in the Semi Arid Parts of the Municipality

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APPENDICES

APPENDIX I

UNIVERSITY OF NAIROBI

DEPARTMENT OF URBAN AND REGIONAL PLANNING

PLANNING FOR SUSTAINABLE DEVELOPMENT OF DOMESTIC WATER WITHIN THE FRAMEWORK OF INTEGRATED RESOURCE PLANNING: THE CASE STUDY OF RUIRU MUNICIPALITY

Note: The information obtained through this questionnaire is purely for academic purposes and shall be treated in confidence.

Instructions: Please respond to the following questions appropriately and as precisely as possible. Tick only ONE most appropriate answer or fill in the most Appropriate responses as the case may be

Researcher: Magondu G.M Interviewer _____

Questionnaire No._____ Date _____

PART A: IDENTIFICATION

Respondents Name (Optional) _____

Locality (Sub-location or area Name) _____

PART B: HOUSEHOLD CHARACTERISTICS

1. Relationship with household head

[1] House head [2] Spouse [3] Child [4] Relative [5] Servant

2. Gender of household head

[1] Male [2] Female

3. Number of children in the household _____

4. Number of servants in the household _____

5. Number of Goats & Sheep _____ Pigs_____, Cattle _____

6. Education level of the household head

[1] University [2] College [3] Secondary [4] Primary [5] No formal Education

7. Main occupation of the household head [ ]

[1] Government employee [2] Private sector employee

[3] Informal sector employee, [4] Self employed, [5] Farmer, [6]Business

[ ]Household head [ ]Spouse

[1] Consultancy [2] Business [3] Farming [4] Remittances

9. Where do you work? [ ]Household head

[1] Within Ruiru [2] Nairobi [3] Out of Ruiru but within Thika district

[4] Out of ThikRuiru But Not Nairobi [5]Outside Kenya

10. Do you commute Daily to place of work?

Household head [1] Yes [2] No [3]Not applicable

Spouse [1] Yes [2] No [3]Not applicable

11.Which is the main mode of transport do you use to place of work?

[ ] Household head

[ ] Spouse Yes

[1] Walking	[2] Boda Boda	[3] Cycling
[4] Matatu	[5] Personal car	[6] Not applicable

12.Which is the main mode of transport do you (Household head/Spouse) use to access vital services such as Health services and administrative services (D.Os office)?

[1] Walking [2] Cycling or Boda Boda[3] Matatu[4] Personal car[5]Multiple modes

13. Which is the main mode of transport that the Household Children use to School?

[1] Walking [2] Cycling or Boda Boda[3] Matatu[4] Personal car[5] School Transport

14. What are the main problems experienced in transportation to place of work, Hospital, D.os Office, School

.e.t.c._____

_____

15.a) How Far is the School from home?

[1] Less than 1km [2] 1-2km[3] 2-4km [4]More than 4km

16. What is the source of drinking water for the school your children attend?

[1] River [2] Shallow Well [3] Borehole [4] Ministry of Water [5] None existence

17.Do your Children carry Drinking Water to School?

[1] Yes [2]No

PART C: LAND TENURE AND LAND USE

18. What is the type of land tenure of your parcel /plot

[1] Freehold title [2] Leasehold [3] Trust Land [4] Government Land

19. Which year did you (household head) settle here?_____

20. How did you acquire the land?

[1] Inherited [2] Original owner [3] Bought

21. Is the Land Formerly Nyakinyua's

[1] Yes [2] No

22. If you bought the land, which year? _____

23. What is the estimated value of your land today (without the developments on it) ksh._____

24. a) Are you engaged in some form of agricultural and livestock activities (urban agriculture) 0n your land?

[1] Yes [2] No

25. If yes, how do these activities affect your water needs and how do you meet them?_____

_____

26. What, in your opinion, can be done or what are you planning to do to improve water accessibility to meet your additional water demand due to your urban agriculture activities?_____

_____

_____

27. Why do you find it necessary to engage in urban agriculture? (Tick the most applicable to your case)

[1] A valuable source of income [2] It's a hobby [3] As a source of food

[4] Because the land is available [5] there are no municipal council restrictions

28. What is the current land use of your parcel?

[1] Purely Residential [2] Commercial [3] Both Residential and Commercial [4] Both Residential and Agricultural [5] Jua kali /industrial [6] Purely Agricultural

What is the future land use of your parcel?

[1] Purely Residential [2] Commercial [3] Both Residential and Commercial [4] Both Residential and Agricultural [5] Jua kali /industrial [6] Purely Agricultural

29. Does the proximity /nearness to Nairobi city influence your land use now and in future? [1] Yes [2] No

30. If yes, how? _____

31.Do you plan to subdivide your land further yes [1] No [2]

32.What is the nature of your house [1] temporary [2] permanent [3] semi-permanent

WATER SUPPLY AND SERVICES

33.What are your main sources of Domestic water supply for the following categories of use? (Indicate in order of main source first)

a) Personal [ ] [ ] [ ]

b) Livestock [ ] [ ] [ ]

[1] Ministry of water supply [2] Public Borehole [3] Private Borehole [4] Shallow Well [5] River/ Stream [6] Dam [7] Rain harvesting Other [8](specify)

34. Is your water supply piped Yes [1] NO [2]

35.If piped, what is the frequency of supply?

[1] Daily [2] 2-3 times per week [3] less than three times per week

36. If not piped, how does it reach you?

[1] Own transport [2] hired motor transport [3] Hired donkey/hard cat transport

[4] Hired bicycle transport [5] Combination of transport modes

37.What are the main water transport do you normally face with regard to roads?

_____

_____

38. What is your approximate daily water demand?

Personal use _____ litres

Livestock use _____ litres

39.Approximately, how much does it cost you per month on Domestic water cost? (Buying or extracting costs + transport costs + treatment costs etc) kshs._____ per month

40.What is the nature and state of your Drinking Water Supply in terms of the following aspects?

a) Quantity [1] very adequate [2] fairly adequate [3] Not adequate [4] scarce

b) Quality [1] very good [2] fairly good [3] poor [4] very poor

c) Distribution [1] Very good [2] good [3] poor [4] Not applicable

41.How far is the nearest reliable water source for

a) Drinking water []

b) Livestock and other uses []

[1] Less than ¼ km [2] Less than 1/2 km [3] 1/2-1km [4] 1-2 km[5] more than 2km

41. Approximately, what is the percentage of your Total income that goes to meet Domestic water costs?

[1] Less than 5% [2] 5-10% [3] 10-20% [4] Over 20%

42. What are the main Domestic Water Supply problems /challenges that you face or likely to face in the near future?

_____

_____

43. What is the furthest distance are you willing to travel to access a reliable water source?

[1] Less than 1/2km [2] Less than 1km [3] Less than 2km

44. How much are you ready to pay for Piped water supply per month?

[1] Less than Ksh. 500 [2] 500-1000 [3] 1000-1500 [4] 1500-2000 [5] Over 2000

45. What, in your opinion could be done to improve on the following Domestic water service aspects for sustainability?

a) Water quantity to meet your daily demand

_____

b) Quantity to meet the required health standards

_____ _____

c) Water distribution to enable you access adequate, safe and reliable water within manageable walking distance

46. What is your main mode of excreta disposal?

[1] Pit latrine [2] Septic tank [3] Sewer [4] Both Pit latrine and Septic tank

47. How does water availability affect your current mode of human waste disposal and general sanitary condition at our home?

_____

_____

48. How do you rate as the current level of engagement/ contribution of the following organizations in the provision of domestic water supply in your area?

A) Municipal council authority [ ]

B) Ministry of water [ ]

C) Private water provider [ ]

D) Institutions [ ]

E) Community based organization (CBO,s) [ ] F) NGOs [ ]

H) Community members as individuals [ ] I) CDC/CDF) [ ]

J) Busies community [ ] K) Provincial administration [ ]

[1] Very engaged [2] fairly engaged [3] poorly engaged [4] not engaged [5] Not sure

Are you involved in the Public or Community water supply affairs of your area?

[1] Yes [2] No

---

50. Are you aware of the ongoing water sector reforms? [1] Yes [2] No

51.If Yes, do you expect the provision of water services to improve?

[1] Yes [2] No [3] Not sure

What do you view as the way forward in supplying adequate and reliable domestic water supply in your area?_____

Thank you very much for your cooperation and contribution to the success of this research

APPENDIX II

INTERVIEW SCHEDULE TO PRIVATE WATER SERVICE PROVIDERS

1. What kind of domestic water service provision do you offer in the Municipality?

(1) Domestic water supply at point of sale only

(2) Domestic water supply at both point of sale and reticulated/piped system

(3) Domestic water supply through reticulation system only

2.What is your main source of domestic water that you provide to Ruiru Residents?

(1) Shallow well (2) Borehole (3) River

3.How do you rate the quality of the source of water?

(1) Very good (2) Fairy good (3) Not sure

4.What are the main problems/ challenges that you experience with regard to the following?

a) Adequacy of the water source

b) Storage of the water

c) Sale of the water (permit, licenses, etc)

d) Reticulation

e) Customers

f) Pollution

g) Operation and maintenance

5.How does the current reforms in the water sector affect the services you offer?

6.Any other information that you consider important in respect of the vital Service you offer

APPENDIX III

INTERVIEW SCHEDULE TO THE INSTITUTIONS

1. What is your main source(s) of domestic water?
2. What is the number of people that you serve in terms of domestic water within the institution?
3. What is the level of?
   (a) Adequacy
   (b) Demand
   (c) Quality of your water source(s)
4. Which are the main problems experienced with water acquisition in your Institutions?
5. Approximately how much do your institute spend per month on domestic Water?
6. What are the designs and operating capacities of your domestic water source?
7. What form of treatment (if any) do you subject your domestic water to?
8. Has there been any reported cases of water borne diseases arising from your Source of domestic water? (Please specify the diseases)
9. What form of assistance (if any) do you expect from:
   (a) The Ministry of Water
   (b) The Municipal authority
   (c) The Constituency Office Development
10. a) Do you have excess capacity that you could sell to the neighbouring Community?
    b) If yes, what are the constraints?

APPENDIX IV

INTERVIEW SCHEDULE TO RUIRU WATER OFFICER

1. What is design capacity of the Ruiru water works?

2. What is the current operating capacity of the water works?

3. What are the main problems/challenges experienced in respect of the Following aspects:

   a) Capacity of the river

   b) River water quality

   c) Treatment of water

   d) Reticulation

   e) Coverage

   f) Customers

4. What is the estimated current Total water demand for the entire municipality?

5. Please give the breakdown of the water demand for the following categories

   a) Domestic
      Residential
      Commercial
      Institutional
   b) Industrial

APPENDIX V

INTERVIEW SCHEDULE TO THE COMMUNITY BASED WATER PROJECT LEADERS

1. In your opinion, what are the main domestic water problems/challenges that the residents you serve experience most in respect of the following aspects?
   a) Source of water
   b) Quality of water
   c) Distribution
   d) Financial sustainability
   e) Members' level of involvement
   f) Technical feasibility (capacity, spares, repairs etc)
2. What form of support (if any) do your project receive from the following Organisations/agencies?
   a) Ministry of water
   b) Municipal council (LATF, etc)
   c) Constituency Development Committee/CDF
   d) Provincial Administration
   e) NGOs and other well-wishers and donors
3. What specific management problems/challenges do you experience and how Could they be mitigated?
4. What is the way forward in terms of adequate, equitable, efficient and sustainable domestic water supply provision in your area of jurisdiction in the face of the current reforms in the water sector?
5. Please give a brief historical and statistical data pertaining to your water Projects in terms of the following aspects:
   a) Name and when stated/registered
   b) Current membership and area coverage
   c) Achievement so far made
   d) Current engagement
   e) Financial status and support
   f) Future plans