

CHALLENGES AND OPPORTUNITIES FOR SUSTAINABLE
WATER SUPPLY AND DEMAND MANAGEMENT IN
RUIRU MUNICIPALITY

By

JACQUELINE WANJIKU NJOGU

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Njogu, Jacqueline
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DECLARATION

This project report is my original work and has not been presented for a degree in any other University or for any other award.

Jacqueline Wanjiku Njogu  16/10/2009
(Reg No: N50/10302/07) Signature Date

We confirm that the work reported in this research project was carried out by the candidate under our supervision and approval as University supervisors

Dr. Abraham Ndung'u  16/10/2009
Kenyatta University Signature Date

Mr. Wilson Nyaoro  10/8/2010
Kenyatta University Signature Date

DEDICATION

To my beloved parents, friends and family

ACKNOWLEDGEMENT

I extend my gratitude to my supervisors Abraham Ndung'u and Wilson Nyaoro for their unfailing assistance through their supervision, positive criticism and discussions. Further I wish to extend my sincere appreciation to Mr. Apollo Minjire, the Thika District Water Officer, for his positive discussions on relevant issues, Mrs. Elizabeth Kihara, the Managing Director RUJWASCO, for her positive discussions and directions on the relevant water issues in Ruiru Municipality and helping in identifying some interviewees. I sincerely acknowledge the working staff of RUJWASCO and especially Mr. Waihenya for taking me around the company's jurisdiction and for arranging the necessary interviews. I owe special mention to the residents of Ruiru Municipality for their cooperation and correspondence.

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ABSTRACT

The water resources upon which human life depends are under increasing stress and almost no country will be spared the negative consequences that are likely to be the result of this situation. Over the next 30 years, more than 60% of the world's population will face water related problems; that is, somewhere between four and seven billion people. Ruiru Municipality will not be an exemption. This study was designed to analyze the level of water supply vis-à-vis increasing demand in Ruiru Municipality. It also identified factors contributing to unaccounted-for water in the area. Further, it evaluated the existing Institutional Arrangements for water supply and demand management. In carrying out the study, questionnaires, interview schedules and guide and an observation recording sheets were used to collect the data. Data collected was collated, coded and analyzed. Data was analyzed descriptively using contingency tables that generated frequencies and percentages. The study established that there is acute water shortage in Ruiru Municipality as demand greatly surpasses water supply. This was attributed to many factors including poor infrastructural development, high water turbidity and pollution levels, lack of funds to invest in water supply facilities, low production capacity of the existing water treatments facilities and regular drought occurrence in the area. The study also found out that the level of unaccounted-for water in the Municipality averages 40%. This was caused by illegal water connections, pipe leakages and bursts and the dilapidated distribution system. It was also found out that the Ruiru and Juja Water and Sewerage Company is the one mandated with water service provision as outlined in the current Water Act. The study found several opportunities for sustainable water supply and demand management in Ruiru Municipality. A sustainable water supply and demand management plan was developed to outline the activities to be carried out in order to realize these opportunities. The study also came up with various recommendations including: proper policy formulations, implementation and enforcement of water resource management strategies, restrict and guide use of groundwater, full decentralization of government functions to the lowest levels possible, review water pricing policies, improve coverage of water supply, construction of a new water intake works, reduce the amount of unaccounted-for water and construction of a sewerage treatment facility.

ACRONYMS AND ABBREVIATIONS

AWSB	Athi Water Service Board
CBO	Community Based Organizations
CDF	Constituency Development Fund
DWD	Department of Water Development
KIRDI	Kenya Industrial Research and Development Institute
LATF	Local Authority Transfer Fund
NEMA	National Environmental Management Authority
NWSC	Nairobi Water and Sewerage Company
NWCPC	National Water Conservation and Pipeline Corporation
RUJWASCO	Ruiru-Juja Water and Sewerage Company
UFW	Unaccounted-for Water
UN	United Nations
WDM	Water Demand Management
WRMA	Water Resource Management Authority
WSB	Water Services Board
WSP	Water Services Provider
WSRB	Water Service Regulatory Board

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND TO THE PROBLEM

Since the launching of the International Drinking Water Supply and Sanitation Decade 1981-1990, much progress has been made globally in increasing access to water supply (UN, 1992). However, despite efforts in providing water in urban areas, service coverage has not managed to keep pace with the increasing population. One of the reasons for this is that the water available in urban areas is inequitably distributed, with middle income and upper income areas consuming much more water than is needed. Leakage losses from the distribution systems are often very high. High consumption can be reduced by the use of the water saving devices so that leakages can be reduced significantly through leak detection programmes. Such a measure can increase the proportion of existing water supplies, thereby making this vital service available to new areas (UN-HABITAT, 1989). This is especially so in low income settlements which house the un-served majority of population in developing countries. Interventions designed to redress the water supply deficit during the above mentioned Water Decade have focused on commissioning of new facilities with very little, if any efforts to identify and promote ways in which existing facilities might be used to provide improved service. This is despite the fact that water conservation measures, if well planned and managed can contribute immensely to expansion and upgrading of existing water supply services (UN-HABITAT, 1989).

The water resources upon which human life depends are under increasing stress. Almost no country will be spared the impending threat. Over the next 30 years (2027), more than

60% of the world's population will face water related problems; that is, somewhere between four and seven billion people (Kofi Annan, 1997).

The World Health Organization, (1996) gives very frightening reality of the water situation in most parts of the world. It notes that every eight seconds a child dies of a water-related disease; every year more than five million human beings die from illnesses linked to unsafe drinking water, unclean domestic environments and improper excreta disposal; at any given time perhaps one-half of all peoples in the developing world are suffering from one or more of the six main diseases associated with poor water supply and sanitation; and nearly a quarter of humanity is without proper access to water and sanitation. This paints a very dark future of water and sanitation situation in the world. .

In 1997, the United Nations predicted that beyond the year 2000, there will be great need of supplies of water for domestic, agricultural and industrial uses while excessive water supplies would cause seasonal flooding. Subsequently global warming may start to increase the sea level leading to possible flooding of low lands. Clean water would become ever-increasingly scarcer, thereby requiring water purifying technologies such as membrane filtering (UN, 1997).

In Kenya water supply is poor for a majority of people with, on the overall, approximately 57% of households using water from sources considered unsafe (GOK, 2004). Sustainable access to safe water is around 60% in the urban setting and drops to as low as 20% in the settlements of the urban poor where half of the urban population lives (Griggs, 1999). With a population growth of up to 10% (Andresen, Lorch & Rosegrant,

1997) in the low income urban settlements many water 'hot spots' continue to develop in many towns and therefore sustainable access to safe water is declining. Vendors sell water of poor quality to consumers who have to spend hours to fetch it at prices that are often between 5 and 20 times the tariff applied on consumers with a metered water connection (Andren, 2004).

The cost of providing water supplies to urban areas has steadily increased over the years and will continue to increase, as the nearby sources are exploited and it becomes essential to transport water from far or extract at great depths. Majority of governmental responses to the problem of increasing urban water supply coverage over the period has concentrated on the construction of new facilities. Amongst the range of options available for maximizing returns from investment in water supply facilities, one which has received little attention but, nonetheless, has a great potential for improving and extending existing supplies, is the application of water conservation techniques (UN-HABITAT, 1989). Water supplies conserved through rational use and appropriate leak detection and repair programmes can increase substantially the quantity of water available for distribution and consumption.

1.2 STATEMENT OF THE PROBLEM

Current patterns of water use in developing countries, countries with economies in transition and industrialized countries alike are often not sustainable. There is mounting evidence that the world faces a worsening series of local and regional water quantity and quality problems, largely as a result of poor resource management, including ill-adapted allocative mechanisms, wasteful use of the resource, unregulated effluent disposal and

weak institutional frameworks. There is also a close interaction with declining biodiversity, desertification and pollution of the marine environment (UN, 1997)

Ruiru Municipality is faced with acute water shortage. The current demand of water for the entire Municipality is quite high compared to the amount of water the municipal is able to supply which leaves a very wide water deficit. The current high demand experienced has been contributed by significant increase in population in the area due to expansion of industrial and agricultural activities that has attracted people in search of jobs. Ruiru town offers housing for people working in Nairobi city and this has increased domestic water demand. The existing water infrastructure in the area was set up in 1950 to supply water to small population present at that time and there has not been any expansions done to cater for the current high population (RUJWASCO, 2008). There are perennial water problems in Ruiru Municipality which mainly include: irregular and unreliable water supply; poor quality of water; irregular billing of customers; poor coverage of water and sewerage systems; and high levels of unaccounted-for water which currently averages at 40%. There is also poor infrastructure and piping networks, which further aggravates water loss. These factors have translated into inadequate service delivery to the population, including informal settlements, where the vast majority of the populations reside. The Municipality has failed to monitor illegal connections and misuse of water and this will continue to hamper any plans to supply area residents with sufficient amounts of water. The current water policies are not adequately capable of handling water crisis in the Municipality.

1.3 RESEARCH QUESTIONS

1. Is the water supply for Ruiru Municipality sufficient to meet the increasing water demand associated with rapidly increasing population?
2. What factors account for water loss in the distribution system within Ruiru Municipality?
3. What are the existing institutional structures for water supply and demand management?
4. What are the weaknesses and strengths of these institutions and how could they be made more effective for the intended purpose?

1.4 RESEARCH OBJECTIVES

1. To provide an analysis of the level of water supply vis-à-vis its increasing demand in Ruiru Municipality.
2. To identify factors contributing to Unaccounted-for Water within Ruiru Municipality.
3. To Evaluate the institutional arrangements for water supply and demand management in Ruiru Municipality
4. To develop a sustainable water supply and demand management plan for Ruiru Municipality

1.5 RESEARCH PREMISES

1. There is deficit between water supplied and actual water demand in Ruiru Municipality.
2. There exist a number of factors contributing to water loss within the reticulation system in the Municipality.

3. The existing institutional arrangements for water supply and demand management in the Municipality are characterized by several weaknesses and gaps and are therefore not effective for the intended purposes.

1.6 JUSTIFICATION

Ruiru Municipality faces acute water shortage problems as indicated in Thika District Development Plan (2002-2008) resulting from population increase therefore straining water resources seriously. As the population is expanding however, water resources are not expanding; on the contrary they are diminishing as humans encroaches the water catchment areas to create space for settlements, agriculture and other anthropogenic activities. With increase in human population, which implies increase in demand, and destruction of water resources, which implies reduction in supply, there is need to formulate strategies to manage demand and supply. In order to achieve water sustainability in this Municipality, the water problems need to be addressed. The Municipality continues to struggle with the problems of water shortages. This research aims to address the issues relating to water demand and supply within the Municipality with the aim of increasing access to water as well as finding ways for water conservation and its sustainable use in the Municipality. It also addresses the problems of the unaccounted-for water in the Municipality with the aim of recommending ways of reducing it to sustainable level. This study is also aimed at improving the performance of public water distribution systems by emphasizing the role of water conservation so as to meet the need of the un-served communities and improve current levels of service.

1.7 SIGNIFICANCE OF THE STUDY

The findings of the study generated vital information for Ruiru Municipality to minimize water problems experienced in the area. With information on the supply and demand patterns, the water service providers were challenged to formulate better strategies to ensure that there is sufficient water supply in the Municipality. The result of this study could help the residents by instilling sustainable water consumption practices. With rapid population increase Ruiru Municipality, there is need to address the problems of water supply so as to ensure that the resource is equitably distributed for current as well as the future generation. The aim of the study therefore, was to make the Municipality improve its water supply and demand management, come up with a systematic and integrated approach in dealing with water shortages, through establishing effective multi-stakeholder process and highlight policy recommendations to address the problem. The recommendations equip policymakers, planners and other stakeholders with the techniques and methodologies required to develop and apply appropriate water supply and management systems.

1.8 SCOPE AND LIMITATION TO THE STUDY

The study was carried out in Ruiru Municipality which covers an area of 292 km² and specifically the area falling under Ruiru and Juja Water and Sewerage Company jurisdiction. The study analyzed the population growth trend in the Municipality and how it affects water supply and demand. The study also evaluated the existing Institutional Arrangements for water supply and demand management in the Municipality, identified factors contributing to unaccounted-for water, and developed a sustainable water supply and demand management plan for the Municipality. The main limitation to the study was the limited resources to comprehensively conduct the research within the given

timeframe. Lack of documented and updated data related to water aspects in Ruiru Municipality was also a limitation to my research. Long bureaucratic procedures were encountered in the study area especially among the institutions interviewed.

1.9 DEFINITION OF TERMS

Institutions

Institutions are generally conceived to be the rules in society that provide constraints on action (Ostrom, 1990). They are formal rules and conventions, including informal codes of behavior or norms, emerging to regulate human behavior and interaction.

Water Demand Management

Water Demand Management (WDM) is a combination of measures to motivate people and their activities to regulate the amount, manner and price in which they access, use and dispose of water, thus alleviating pressure on freshwater supplies and protecting quality.

Unaccounted-for Water

Unaccounted-for Water (UFW) is the difference between the water supplied to a distribution system and the water that leaves the system through its intended use. It is all water that cannot be accounted for through measurement or estimation.

CHAPTER TWO

LITERATURE REVIEW

2.1 KENYA WATER SUPPLY SITUATION

Kenya gained independence in 1963. At that time, the existing water supply systems were largely sufficient in meeting the needs of the country's population. This was not so in arid and semi-arid areas, where lack of water was and still is a prevailing problem. However, as population grew, demand began to outstrip supply in most parts of Kenya. The annual quantity of renewable fresh water resources is estimated at 20.2 billion m³ comprising of 19.59 m³ surface water and 0.62 billion m³ of ground water. Given the country's population of over 30 million people, per capita supply is approximately 696m³ per person per year, which makes Kenya water scarce country since the global bench mark is 1,000 m³ per person per year (Njonjo, 1997). Even though growth of urban areas has occasioned development and water re-allocation from the rural to urban areas of Kenya, problems of urban water scarcity continue to intensify as these areas have rapidly grown in size and density and become focal point of industrial activity (Sumila, 2005).

2.2 WATER SUPPLY AND POPULATION GROWTH

Prime cause of global water concern is the ever-increasing world population. As population grows, industrial, agricultural and individual water demand escalates. According to the World Bank, worldwide demand for water is doubling every 21 years, and in some regions, it is more (World Bank, 1997). The annual population-growth rate of most countries in the region is 2.5-3.1%. This high growth rate, combined with economic development, results in ever-increasing demands for a finite resource. Hence, water availability per capita is steadily decreasing. Human activities have impacts not

only on the water quality but also on the general availability of water resources and the state of aquatic ecosystems (Terence, 1991).

Rapid urban population growth over the past years has introduced important implications for the environment. Urban domestic and industrial consumers are using larger amounts of water and, consequently depleting the available sources. At the same time, they are degrading these resources with their wastes. Yet, urbanization and the consequent concentration of production are an essential part of economic development. They help lower unit costs for water supply systems and for many forms of sanitation services, including access to health services (Savic, 2005). However, in developing countries, the rate of investments needed to provide water supply and sanitation falls behind the urban growth, leading to a situation of intense pollution due to the concentration of industrial and domestic wastes. In these countries the problem is aggravated due to the unplanned way the cities grow.

Rapid population increase is exerting enormous pressure on water resources by increasing water demand both for domestic and for industrial uses. If the trend continues, per capita water supply will reduce dramatically posing a threat to the population as well as the environment. Water sources in a specific region vary in the quantity and quality of water they contain at a given time and in their rate and timing of replenishment. If projected withdrawals to meet population growth exceed the ability of the water sources that may be called upon to meet them, then new sources must be developed, if that is possible; otherwise, cutbacks in water use will be required. Yet demands can be

decreased only so far until the decreases may endanger public health, damage the environment, or adversely influence the region's economy. Sustainable growth levels in many localities around the world are already being exceeded because population growth outpaces water supply capabilities (Kindler and Russell, 1984).

Figure 2.1 shows the predicted per capita water availability (m^3) by the year 2010 in Kenya by the Ministry of Water and Irrigation. Just after the independence, water was in plenty and mostly clean therefore, available for use to many people directly from the Rivers, lakes or underground water. However, population and industrial activities have increased steadily over the years and this has increased water demand both at household and industrial level. Population increase has led to water catchment encroachment in search of land for settlement and for agricultural activities thus reducing the replenishment rate of both surface and underground water sources. Industries have led to water pollution as many discharge their harmful wastes directly in to the Rivers lending the water unsafe for human consumption. All these factors have led to decreased water available for use. The figure 2.1 shows the way the available water for use per person has reduced over the years and how it will continue to reduce (GOK, 1999).

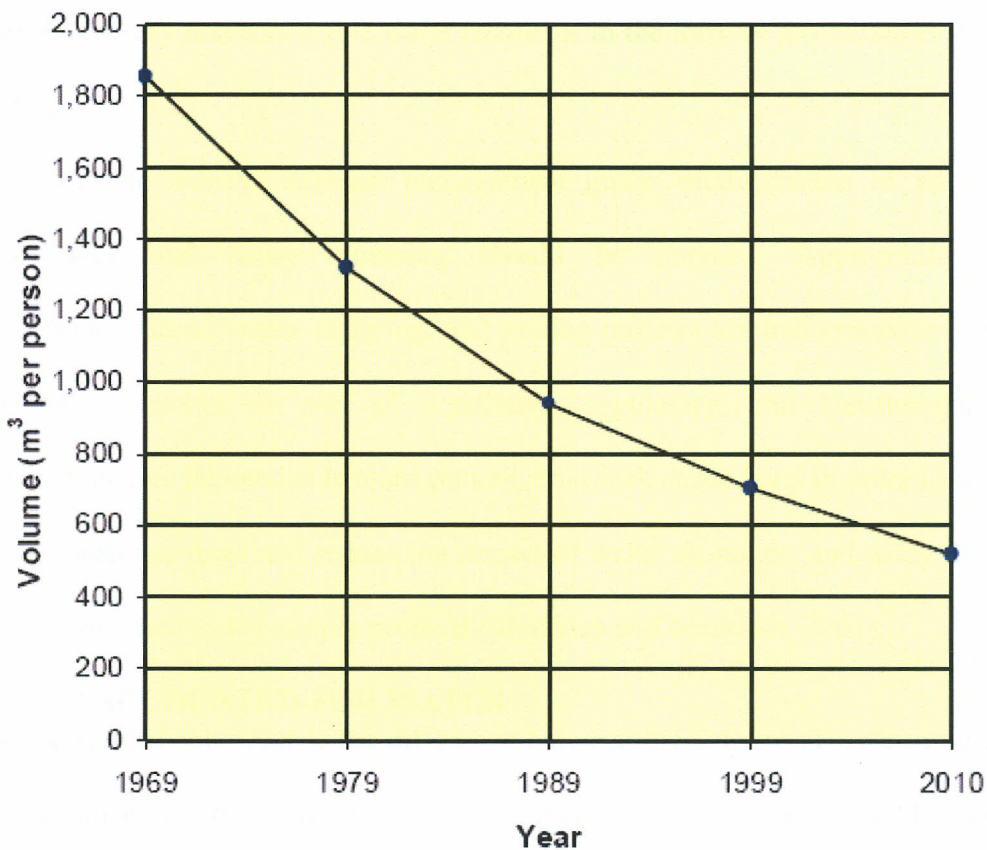


Figure2.1: Per capita water availability

Source: Ministry of Water and Irrigation (1999)

2.3 WATER DEMAND

Despite recent improvements in the efficiency of water use in many developed countries, the demand for water has continued to rise as the world's population and economic activity has increased. From 1940 to 1990, withdrawals of freshwater have increased by more than a factor of four, more than double the rate of population growth. Current total human usage is about half of the total available water identified above (UNHABITAT,2004). With a 50% increase of the total world population forecast for the next twenty-five years, this alone unchanged would approach the limit of water availability. One important consequence of the growing demand is the increasing reliance

on essentially non-renewable water resources in the form of groundwater (UNHABITAT, 2004).

In order to achieve demand management goals, establishment of adequate policies, strategies and action planning should be pursued. Appropriate technological implementations, water metering, and pricing policies are indispensable elements in this global campaign as part of legislative, regulatory, and institutional reforms, to accommodate demand side management, on a wide-scale level in order to reach relatively large water savings and reduce the impact of water shortages, and delay the execution of expensive new water supply projects (Maddaus and Maddaus, 2001).

2.4 UNACCOUNTED-FOR WATER

Unaccounted-for-water is the difference between the amount of water a utility purchases or produces and the amount of water that it can account for in sales and other known uses for a given period. Both the age of the water system and the characteristics of the population served by the system can affect the amount of unaccounted-for-water. Unaccounted-for water is very difficult to calculate if a water system is not metered. If the system is partially metered, then estimates can be made to account for water leaving the system that is legitimately being used in useful ways (e.g. fire fighting, hydrant and water main flushing, water quality, etc.). It is important that water utilities recognize and estimate these uses so that they can accurately determine the magnitude of losses such as leakage, illegal connections or theft, and inaccurate metering (Griggs, 1999).

According to Maddaus (2001) a public water supplier may have a high percent of unaccounted-for water, if it has:

- i. Inaccurately estimated the amount of water pumped or purchased due to not metering all water at the intake source or by using raw water or finished water meters that are inaccurate or improperly installed;
- ii. Inaccurate customer meters;
- iii. Bookkeeping errors;
- iv. Non-metered uses such as water used in the treatment process, city buildings, churches, watering a golf course, etc. or
- v. Water leaks.

2.5 INSTITUTIONAL ARRANGEMENT

Institutional aspect has been understood in the past decades as the crucial prerequisite to solve municipal water supply and management (IRC, 1995). Water issues are all aggravated by a general weakness among the institutions dealing with water affairs. It is widely recognized that the serious economic and technical problems associated with balancing supply and demand cannot be solved without first paying attention to the institutional context of water management (Griggs, 1999). Kenya's water supply and demand management strategies are spelt out in Water Act (GOK, 2000), which provides the legislative framework governing the water sector. Its preamble says it's an Act of Parliament, 'To provide for the management, conservation, use and control of water resources and for the acquisition and regulation of rights to use water; to provide for the regulation and management of water supply and sewerage services; to repeal the Water Act (Cap.237) and certain provisions of the Local Government Act; and for the related purposes''. Before the Water Act was revised, inadequate and insufficiently harmonized legal and institutional frameworks as well as inefficient operational and financial management systems characterized it.

Under the current Water Act (Cap. 237), six water basins were established. Each authority is based on hydrological boundaries and assume responsibility within those boundaries for the planning, design, construction, operation, finance, and ownership of facilities for water resources development; provision of sewage and treatment of wastewater and their disposal; restoration and maintenance of the quality of the nation's water; the use of waters for recreation and the enhancement of amenity values; flood prevention and land drainage and fisheries and navigation in inland waters (Rose, 1999).

These six drainage basins include:

- Lake Victoria North Catchment Area.
- Lake Victoria South catchment Area.
- Rift Valley Catchment Area.
- Tana Catchment Area Basin.
- Athi Catchment Area
- Ewaso Nyiro North Catchment Area.

2.6 THEORETICAL FRAMEWORK

This section provides a theoretical analysis of absolute and relative performance of three alternative types of water management in city regions in developing countries, namely central-government and local-government agencies, and private monopoly firms. The local water agency is assumed to take three different possible forms. Central-government water administration, with the basic aim of covering costs; here little incentive is assumed to be present for cost reductions or recovery. Part of gross revenue is eaten up by administration and overstaffing/spending or used to pay off old water-sector debts, and there is a high rate at which customer payments are avoided or evaded (Barrett, 1996). Any possible surplus is spent on various investment costs. Municipal water administration; this is assumed to operate in a similar way to a central-government administration, with the difference that incentives for cost recovery are greater, and there is less slack. A private firm which aims to maximize profits, under certain constraints; one constraint may be water price regulation by either a government agency or a political decision-making body.

The water allocation problems encountered in cities in this region are largely threefold: low coverage levels, whereby many households are not covered by regular water service, and where those not covered must rely on other more expensive and less reliable sources (Barrett, 1996). Low service quality level for households covered by the regular system e.g., water service may be provided only during part of the day or sometimes not at all, water pressure is often poor, and the water may have low quality. Low overall supply of water to many individual urban regions, results from a failure to make required water

system expansion investments. The figure 2.2 demonstrates that for improved efficiency therefore, participation of all stakeholders is mandatory.

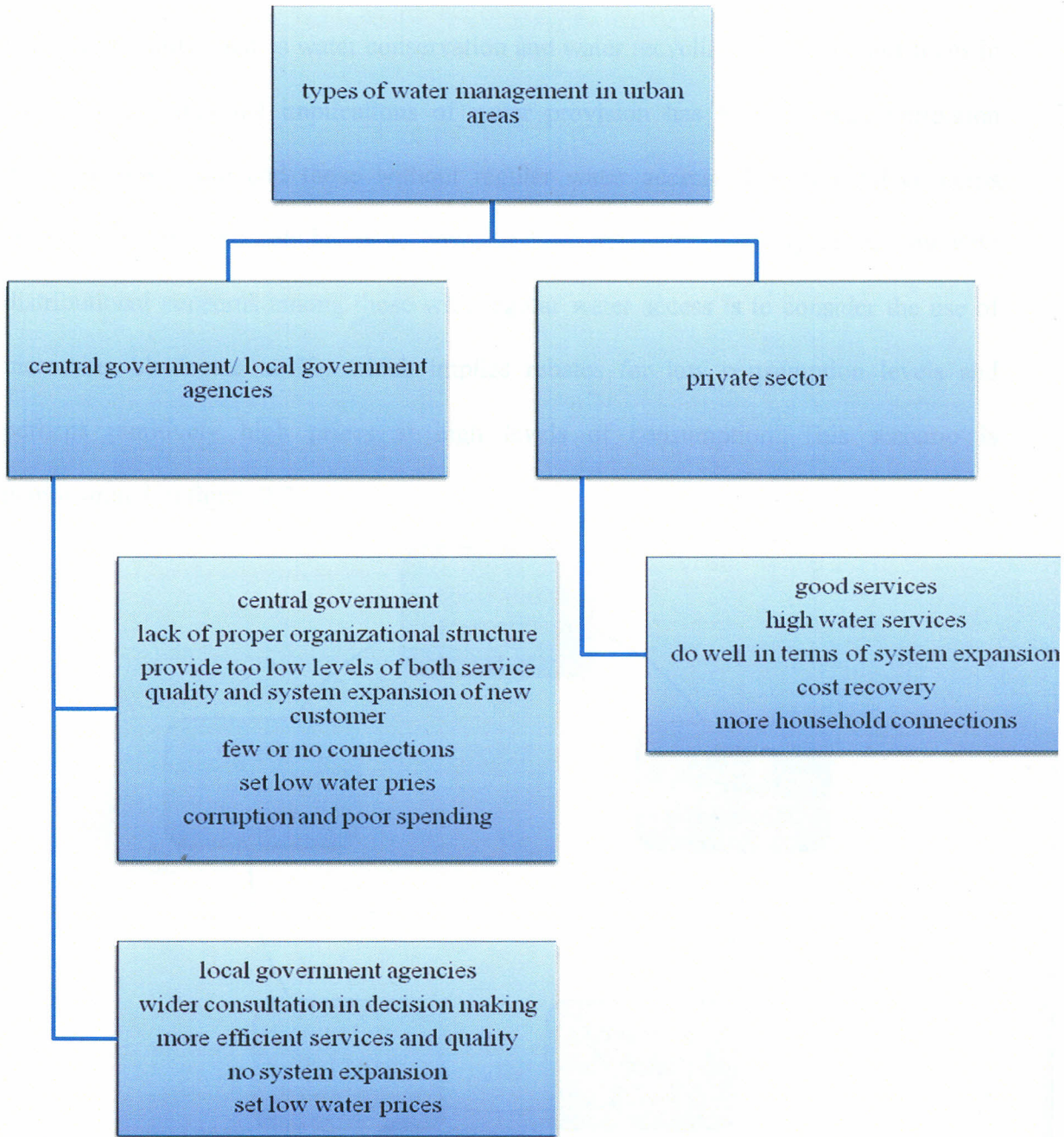


Figure 2.2: Theoretical model
Source: Barrett, G. (1996)

2.7 CONCEPTUAL FRAMEWORK

A number of issues have been ignored in above analysis. First, it ignores the population projections and its influence on demand which should be put in perspective. Issues related to water system expansion should take into considerations measures of increasing water availability such as water conservation and water recycling. Secondly, our focus in terms of distributional implications of water provision has been on the distribution between those with and those without regular water access. Distributional concerns among connected households have however been ignored. One way of dealing with distributional concerns among those with regular water access is to consider the use of increasing block-rate tariffs, which implies rebates for low consumption levels and perhaps punitively high prices at high levels of consumption. This scenario is demonstrated in figure 2.2.

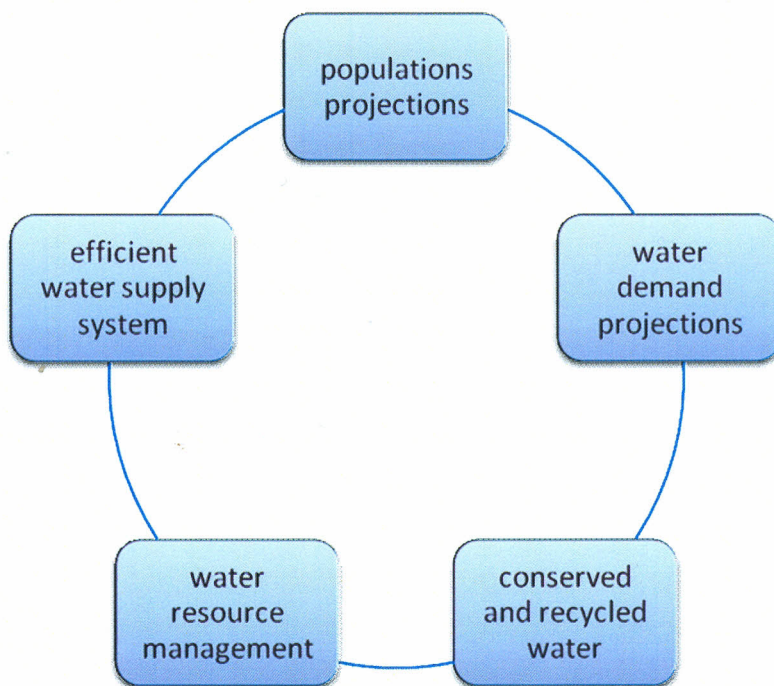


Figure 2.3: Conceptual model

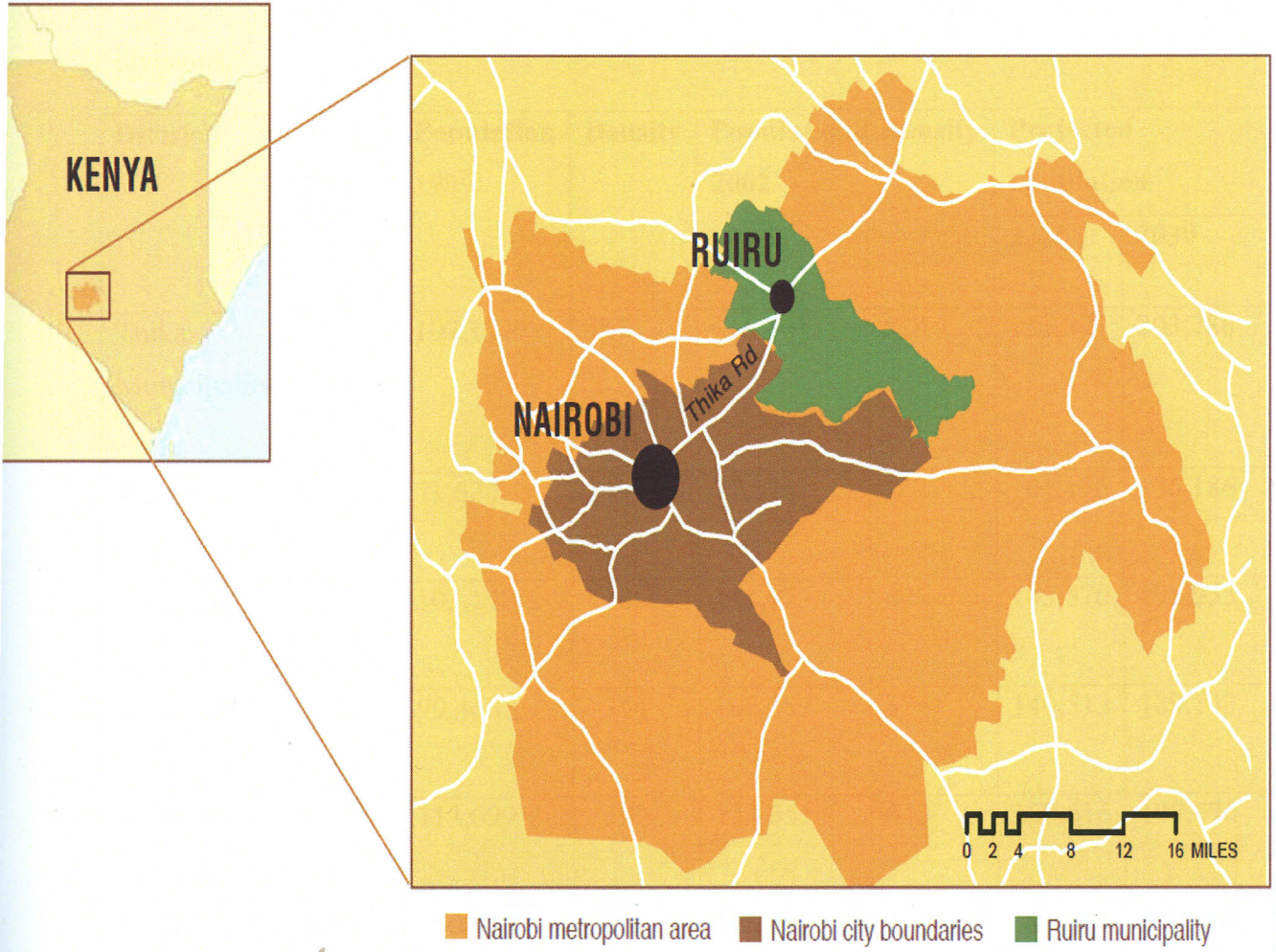
Source: Own model (2009)

CHAPTER THREE

STUDY AREA

3.1 LOCATION

Ruiru Municipality is located in Kenya's Central Province formerly within Thika District, but with the current revision and curving out of the new districts, it is within the new Ruiru District. It lies between latitudes $3^{\circ}53'$ and $1^{\circ}45'$ south of Equator and longitudes $36^{\circ}35'$ and $37^{\circ}25'$ east. The town is located along the Nairobi-Thika highway, 16km from the Nairobi City Center and less than 3km from the Nairobi City Boundary. It is accessible by both railway and highway and has a fertile hinterland. The entire Municipality covers 292 km². As a satellite town of Nairobi, it is growing in response to the demand of housing in Nairobi. The location is shown in figure 3.1.



re3.1: Study Area

3.2 POPULATION DISTRIBUTION

Table 3.1 shows the population distribution and densities by divisions in Thika district. It shows that Ruiru division is the highly populated division although the densities are medium owing to the spatial area of the division that also is the largest among the divisions.

Division	Area (km ²)	Population 1999	Density	Population 2002	Density	Projected population	
						2015	2030
Thika Municipality	220.2	107,174	487	116,461	529	151,391	203,786
Kakuzi	481.2	71,622	149	77,828	162	101,176	136,186
Gatanga	251.1	103,148	410	111,977	446	145,570	195,955
Kamwangi	289.0	99,460	344	108,087	374	140,513	189,143
Gatundu	192.1	113,699	592	123,551	643	160,616	197,676
Ruiru	526.6	150,710	286	163,769	311	193,361	210,107
Total	1960.2	645,713	329	701,664	358	892,627	1,132,853

Table 3.1: Population Distribution and Densities by Divisions

Source: District Statistics Office, Thika (2008)

Within Ruiru Municipality, population density varies for instance; there is high population density in Ruiru town while the lower parts are sparsely populated. Due to

rapid population growth in the Municipality, there is an increased imbalance between supply of demand for basic facilities such as schools, health facilities, water supply and other facilities. However, the population is projected to increase as Ruiru town grows as a satellite town, and more industrial activities are expected which will further exert pressure on already limited water facilities in the region. Table above shows the projected population for Ruiru Municipality up to the year 2030 in line with Kenya's vision 2030.

3.3 TOPOGRAPHY

Topographic features have not only influenced its climatic conditions but also economic development of the area. The higher areas to the west are characterized by deeply dissected topography with numerous slopes giving rise to ridge and valley patterns, while the Eastern parts are lowlands. The elevation of the area ranges from 1,550 m to 1460 m above sea level .The general slope of the area is to the east and southeast. The natural drainage within the area is dictated by the Rivers and streams that cross the road and they flow from the Aberdare Ranges and Kikuyu dip-slopes to the west and flow south-eastwards forming the headwaters of Kenya's two main Rivers, the Tana and Athi Rivers, which eventually flows into the Indian Ocean. The major sub-catchment areas in the project area are the, Kamiti River, Ruiru River, Theta/Thiririka River Sub-Catchment, and Ndaragu Sub Catchments. The flat topography is characterized by low rainfall and well-drained soils making it suitable for irrigated plantation farming. Cut-flower production is also an upcoming economic activity. Examples include many greenhouses located within the area such as Sophia Roses and Penta Flowers companies. Coffee and sisal production used to be the main cash crops in the area but since the sisal processing company closed down, sisal production was halted and only grows wild. It is significant

to note that while the streams and Rivers are important source of piped water, they pose a major obstacle to road transport as they necessitate the construction of many bridges and high maintenance costs.

3.4 GEOLOGY

Availability of ground water depends mainly on the type of and nature of rocks underlying a particular area. In Ruiru Division, more than 95% of the rock outcrop is volcanic, underlain by the Kapiti Phenolite, below which lies the basement system. The volcanic rocks have a good ground water capacity when associated with adequate recharge (GOK, 2000). The area has a high potential for underground water. There are many boreholes scattered in Ruiru Municipality. Examples include Murera Mbugu, Mugutha and Ruiru East boreholes, which supplement water for use by the nearby communities. Many private premises and institutions also have their own boreholes.

Soils between Thika, Ruiru and Kahawa are shallow, yellow-brown to yellow-red friable clays overlying a laterite horizon. Surface water is abundant in the area, and there are streams and Rivers crossing the area. However, many of the Rivers are polluted. Most of the pollution originates from settlements and urban centres and drained to the Athi River system. Ruiru and Ndaragu Rivers largely carry agricultural based pollutants.

3.5 CLIMATE

In general temperatures are fairly uniform with coolest months occurring from June to August while hottest temperatures typically occur from December to March. The area has a mean temperature of 20°C with coldest months being June, July and August. The hottest months are January, February and March. Temperatures also vary within the year

with a minimum of 8°C and maximum of 30°C. The area has one significant water dam, which is Ruiru water dam. The area has a bi-modal rain pattern with long rains occurring from March to May while the short rainy period occurs from October to November. The average annual rainfall ranges from 965 mm and 1,250 mm per annum.

3.6 VEGETATION

Vegetation generally comprises grassland characteristic of savanna and scattered tree species. The region depicts a transitional zone from the high rainfall areas to the west with forested areas to the semi-arid area is to the east. However, again due to intensive human activities, the natural vegetation has all but disappeared. There is a unique notable wetland system on Ruiru River comprising mainly of *Cyperus papyrus* species mixed with grasses and minor shrubs. Along sections of the road, various private and public initiatives have been taken to plant mixed tree species. With the exception of irrigated farming, agricultural activities and types of crops being grown in the district have heavily been determined by rainfall patterns.

The northern and western parts, which receive 1500 mm minimum annual rainfall, coffee and dairy farming are the dominant economic activities. In the semi arid areas to the east with low and unreliable rainfall, cattle rearing and production of drought resistant crops are the main preoccupation of farmers. Cotton, a drought resistant crop can do well in this area but currently the potential is not being exploited. There is no significant wildlife in the area, a situation associated with intensive human activities and no migratory routes exist across the road.

3.7 LAND USE

The area is characterized with mixed land use patterns that include residential plots and business premises such as petrol stations, commercial premises, shops, catering, stores and educational institutions. Extraction of building stones from quarries in Juja is quite vivid. There is a thriving informal sector (Jua kali) specializing in metal work, carpentry, vehicle repairs, dressmaking and construction. Other notable land uses include farming (in food and cash crops) as well as livestock keeping for meat and dairy. Roadside traders are also a common feature in fodder, vegetables, Napier grass, tomatoes, maize, beans, tree nurseries and other farm products. Some commercial agriculture also takes place in the road corridor such as horticulture flower growing and coffee farming.

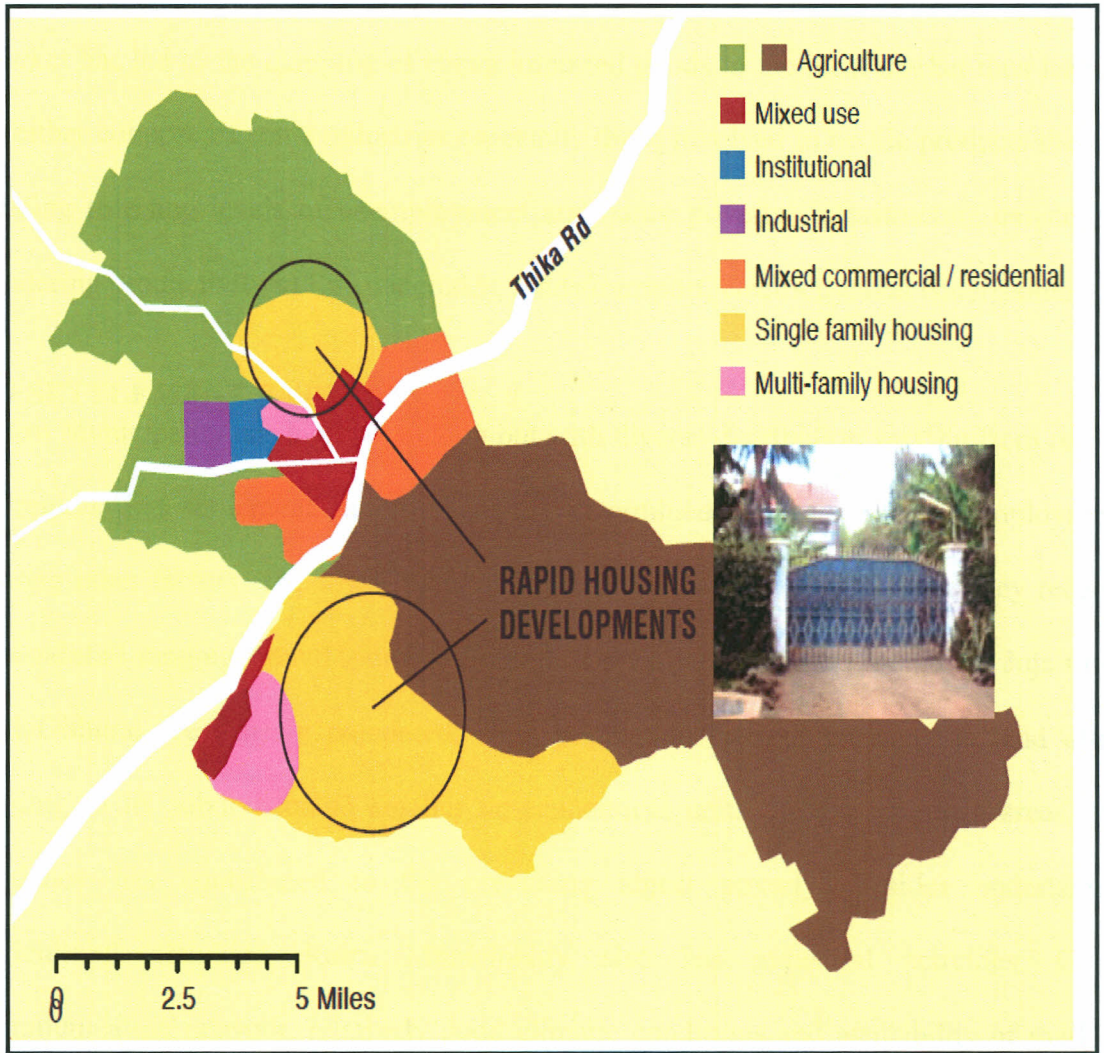


Figure 3.2: Land Use Map of Ruiru

3.8 TRANSPORTATION

Ruiru's growth can be attributed to its proximity to Nairobi. Traffic between the two clogs the highway as commuters travel to and from work. As Ruiru's population grows, it is likely that the traffic between it and Nairobi will increase, worsening the problem. A transportation plan linking the two cities will be a key component of Ruiru's sustainable growth. Poorly maintained road network has adversely affected marketing of agricultural

and industrial products due to increased cost of transportation. Liberalization of global market has led to the damping of cheap imported goods in the local market thus leading to either collapse of some industries especially those involved in textile products thereby leading to rising levels of unemployment and hence poverty. Infrastructure constraints hindering productivity in Ruiru includes: roads/transport, electricity, and water/sanitation

3.9 SETTLEMENT PATTERNS

Ruiru Municipality has high population but with diverse distribution varying from region to region. The settlement pattern is mainly determined by availability of employment among other factors. The lower parts of Ruiru have the least density since they receive low rainfall ranging from 116mm to 965mm. Upper parts of Ruiru including, Juja town and Githurai are densely populated. High population has put pressure on land often leading to its subdivision to smaller un-economical units. In the semi-arid areas, the tendency has contributed to the prevailing abject poverty. Besides undertaking agricultural activities, Ruiru Municipality also has industrial activities. Good communication network, relatively good climatic conditions and availability of market, availability of raw materials and labour among other things have to a large extent contributed to active economic activities in the area and hence the high population densities. Ruiru will suffer from the sprawl of informal housing and markets, as well as the loss of all fertile land to housing subdivisions

CHAPTER FOUR

RESEARCH METHODOLOGY

4.1 INTRODUCTION

This chapter discusses research design and methodology, which focuses on the nature and sources of the data, methods of data collection, sampling procedures, the population, the analysis and the presentation of data.

4.2 NATURE AND SOURCES OF DATA

4.2.1 Nature of Data

The study was designed to outline the challenges and the opportunities for sustainable water supply and demand management in Ruiru Municipality. In particular, the study examined the level of water supply vis-à-vis the demand, the factors contributing to unaccounted-for water and the Institutional Arrangement for water supply in the Municipality. The data collected was intended to develop a sustainable water supply and demand management plan for Ruiru Municipality.

In order to achieve the purpose of the study, the information collected included: the population both served and un-served by water supply, causes of unaccounted-for water, demand management strategies, water availability both surface and ground water, levels of water pollution, water supply institutions and the problems they face, the institutions role in promoting sustainable water supply and demand management and the options that need to be explored in order to enhance sustainable water supply and demand management in Ruiru Municipality.

During the field survey, the data gathered was in two forms namely primary and secondary data. The primary data comprised of information sourced from views, opinions, and facts given by the officials and resource persons in Ruiru Municipality, private water providers, water vendors and government officers. The data was collected using questionnaires, interviews and discussions from target population and also through direct observations.

4.2.2 Primary Data

Data observed or collected directly from first-hand experience. The primary data was obtained from households who were either served or un-served by RUJWASCO who gave their information on the situation of water supply in the Municipality. Information was also gathered from the relevant institutions dealing with water supply in the Municipality including the Ministry of Water and Irrigation district offices. The resource persons included the current director of RUJWASCO and the management staff.

4.2.3 Secondary Data

Published data and the data collected in the past or other party is called secondary data. Secondary data included information from published and unpublished sources. The data was obtained through literature review from libraries, published and unpublished information from government agencies, administrative information compiled on Ruiru Municipality, both topographical and geological maps, data from websites and reports on previously done studies such as thesis, dissertation and project reports.

4.3 TARGET POPULATION

The target population of the study included the Water Department Officials at district level, Ruiru and Juja Water and Sewerage Company, water vendors, Municipal residents and business community and Water Policy Formulators. In this regard the field survey

involved conducting interviews with resource persons from the named groups. These persons formed the unit of analysis.

4.4 SAMPLING PROCEDURE

Since the study did not cover the entire population, a sample upon which inferences were made was taken. This gave representative information about the population at a minimum cost and time. The following sampling methods were used.

4.4.1 Stratified Random Sampling

A general problem with random sampling is that you could, by chance, miss out a particular group in the sample. Stratification is most useful when the stratifying variables are simple to work with, easy to observe and closely related to the topic of the survey. Stratified sampling is commonly used probability method that is superior to random sampling because it reduces sampling error. The population was divided into groups called strata. A sample was then drawn from within these strata. The relevant strata were first identified and their actual representation in the population. Random sampling was then used to select a sufficient number of subjects from each stratum. "Sufficient" refers to a sample size large enough for us to be reasonably confident that the stratum represents the population. Stratification of the population was done following the population groups into low, medium and high-income earners and random samples were then drawn from each stratum. The sampling procedure ensured that the stratified population who are affected by water supply in the area had equal chances of being interviewed.

4.4.2 Purposive Sampling

In purposive sampling, sampling is done with a purpose in mind. We usually would have one or more specific predefined groups we are seeking. Purposive sampling can be very useful for situations where you need to reach a targeted sample quickly and where

sampling for proportionality is not the primary concern. With a purposive sample, you are likely to get the opinions of your target population, but you are also likely to overweight subgroups in your population that are more readily accessible. In this research study, purposive sampling technique was used to determine the institutions with relevant information with respect to the objectives of the study from which data was then be collected. It was deliberately used to gain access to the relevant resource persons.

4.4.3 Simple random sampling

In random sampling, all items have some chance of selection that can be calculated. Random sampling technique ensures that bias is not introduced regarding who is included in the survey. With simple random sampling, each item in a population has an equal chance of inclusion in the sample. The advantage of simple random sampling is that it is simple and easy to apply when small populations are involved. However, because every person or item in a population has to be listed before the corresponding random numbers can be read, this method is very cumbersome to use for large populations. This method was used in this study to gather data from the residents and the business community. This procedure was preferred due to the way the living units are arranged since there is no planning.

4.4.4 Snowball sampling

Snowball sampling is a special non-probability method used when the desired sample characteristic is rare. It may be extremely difficult or cost prohibitive to locate respondents in these situations. Snowball sampling relies on referrals from initial subjects to generate additional subjects. While this technique can dramatically lower search costs, it comes at the expense of introducing bias because the technique itself reduces the likelihood that the sample will represent a good cross section from the population.

In snowball sampling, you begin by identifying someone who meets the criteria for inclusion in your study. You then ask them to recommend others who they may know who also meet the criteria. Although this method would hardly lead to representative samples, there are times when it may be the best method available. Snowball sampling is especially useful when you are trying to reach populations that are inaccessible or hard to find. This method was used commonly within the institutions whereby one institution referred to another institution with relevant information. For example, RUJWASCO referred Water Resource Management Authority for information regarding water resource management. Also it referred to community run boreholes for more information on management of those boreholes.

4.5 DATA COLLECTION

Several methods were used to collect primary data from the field. They include:

4.5.1 Questionnaires

Questionnaires are a popular means of collecting data, but are difficult to design and often require many rewrites before an acceptable questionnaire is produced. They can be used as a method in its own right or as a basis for interviewing and can cover a large number of people or organizations. They are relatively cheap and no prior arrangements are needed. Questionnaires were administered to the residents of Ruiru Municipality, water vendors and business community. Institution questionnaires were also administered to the resource persons (appendixes 1&2)

4.5.2 Oral Interviews

Interviewing is a technique that is primarily used to gain an understanding of the underlying reasons and motivations for people's attitudes, preferences or behaviour.

Interviews can be undertaken on a personal one-to-one basis or in a group. They can be conducted at work, at home, in the street or in a shopping centre, or some other agreed location. They have good response rate and are completed immediately though they are time consuming. More information concerning the study was obtained from the district water offices, Water Resource Management Authority offices and from current manager of RUJWASCO using the interview schedules.

4.5.3 Observation

Observation involves recording the behavioral patterns of people, objects and events in a systematic manner. In unstructured observation, the researcher monitors all aspects of the phenomenon that seem relevant. It is appropriate when the problem has yet to be formulated precisely and flexibility is needed in observation to identify key components of the problem and to develop hypotheses. The potential for bias is high. Observation findings should be treated as hypotheses to be tested rather than as conclusive findings. Observation was done at all stages of data collection. Observation was done to determine the water leakages, unlawful water use and to assess the status of water supply in the area.

4.5.4 Photography

Photography was used to collect evidence of the observed information. The primary data collected through this method include: the water intake and treatment plant, the boreholes, water leakages and state of water pollution.

4.6 METHODS OF DATA ANALYSIS AND PRESENTATION

All collected data was analyzed using both quantitative and qualitative data analysis techniques in order to facilitate presentation of summarized data, enable assimilation of

data, and provide a quick comparison between different sets of data. Data gathered from research questionnaires was edited, coded and subjected to descriptive statistics for calculation of frequencies, means and percentages, and results presented in figures, tables, graphs and charts. Qualitative data was edited, organized descriptively into themes, coded and presented in discussion, narrative form and citations. For ease of quantitative data analysis, the Statistical Package for Social Sciences (SPSS) was used.

4.7 CONSTRAINTS TO DATA COLLECTION

A number of constraints were present during data collection. It was not possible to transverse the whole Municipality because of its spatial extent and also due to lack of transport to interior parts. The resource persons had limited time for interviews meaning that exhaustive discussions were never held. Also some resource persons were not willing to share their information for fear of being disclosed. To obtain some information was risky especially on illegal water connection since the involve parties were hostile and did not want to be interviewed.

CHAPTER FIVE

DATA ANALYSIS AND DISCUSSION

5.1 THE LEVEL OF WATER SUPPLY VIS-À-VIS INCREASING DEMAND IN RUIRU MUNICIPALITY.

5.1.1 Water Supply

The supply of water from the facilities indicated in the Table 5.1 does not meet the demand of the communities who rely on them. According to RUJWASCO, the demand of water is high in Ruiru (24,000m³ per day) and water supply (4000m³ per day) is far below the demand. This is partly because the Ruiru water supply system was originally designed for small population but the population and the number of industries have been increasing steadily in the recent years. The area thus lack sufficient water supply for domestic use.

Water source	Production capacity (m³/day)	Actual yield (m³/day)	Area of coverage
Ruiru water supply	1,000	700	25%
Boreholes (RUJWASCO)	360	240	10%
NWSC	400	100-150	5%
Community water projects (boreholes)	5,000	2,000	20%

Table 5.1: Water Sources

Source: RUJWASCO (2008)

Water supply coverage by RUJWASCO in the area of its jurisdiction is very low and its rated 25%. The rapid growth of population in the area has sharply increased demand while supply has been restricted by unavailability of adequate resources to improve or develop the necessary infrastructure. The design of the existing water systems is outdated and their rehabilitation and extension remain a priority for efficiency.

The study found out that the major source of water in the area is surface water mainly from Ruiru River that passes through the Municipality. However, that water is unsafe for drinking directly without treatment because of high pollution levels especially from the industries within the Municipality and also from agricultural and other human activities in the area.



Plate5. 1: Water intake works on Ruiru River
Source: Field data (2009)

Another water source is ground water from boreholes. There are three major boreholes run by RUJWASCO, each with a potential of producing approximately 80m³ of water per day. These boreholes combined boost the water supply by about 240 m³ per day. Initially when the boreholes were constructed, they produced about 10,000 litres of water per hour, but since then the production has gone down to about 5,000 litres per hour. This reduction in water quantity supplied by the boreholes can be attributed to the prolonged effects of drought, ageing of the facilities and excessive abstraction of underground water with little replenishment. The use of boreholes in the area has increased because the residents consider borehole water relatively clean for consumption as compared to Ruiru River water, which is highly polluted. Apart from the boreholes run by the company, many individual households also have their own boreholes to provide water for their household uses.

It is also evident that almost all the industries in the area have their own boreholes sometimes even three boreholes in the same company. Examples of the companies with their own boreholes include Spinners and Spinners Company Limited, Henkel Chemical Industries, Premier Industries, Bogani Industries, Jetlak Food Industries and Kenyatta University Ruiru Campus. Some companies like Spinners and Spinners have excess water from their boreholes for their industrial which and they supply the excess to all their working staffs and even have two public water points, which are accessible to public freely.

In addition, RUJWASCO has contracted NWSC to supply water to some areas falling under RUJWASCO jurisdiction that neighbours Nairobi Municipality. This is because supply of water by RUJWASCO to these areas is limited since it lacks adequate capacity both in terms of infrastructure development and in terms of water quantity to supply water. These include Githurai, Kahawa and areas around Kenya Clay works Company Limited. It has been recorded that NWSC supplies amount of water averaging 100-150 m³ per day. The area covered by NWSC currently has about 200 water connections serving approximately a 1,000 people.

There are also community water projects which supplement water supply in the region. Currently, there are over 27 Community Water Projects, 17 that are funded by CDF. The capacity of the boreholes in the area is over 2000m³ of water per day. They serve about 70,000 people and they have increase water supply coverage by over 20%. RUJWASCO is involved through design, construction and managing the water projects. Problems facing Community Water Projects include inadequate funds, lack of adequate storage facilities and water rates that are charged high compared to those of Ruiru water supply. The advantages of community water projects are that they provide alternative water supply, increased water supply coverage and increase employment opportunities to the population served. However, these community water projects charge high water rates compared RUJWASCO. In addition, they charge high connection fee.

There are also Private water suppliers in the area. Over 20 private water projects/suppliers supplement water supply services to the residents of Ruiru. However,

the exact data as to how much water they supply to the residents of Ruiru Municipality is not available since no recording has been done. The diagram 5.1 summarizes the major sources of water in Ruiru Municipality as indicated by the respondents

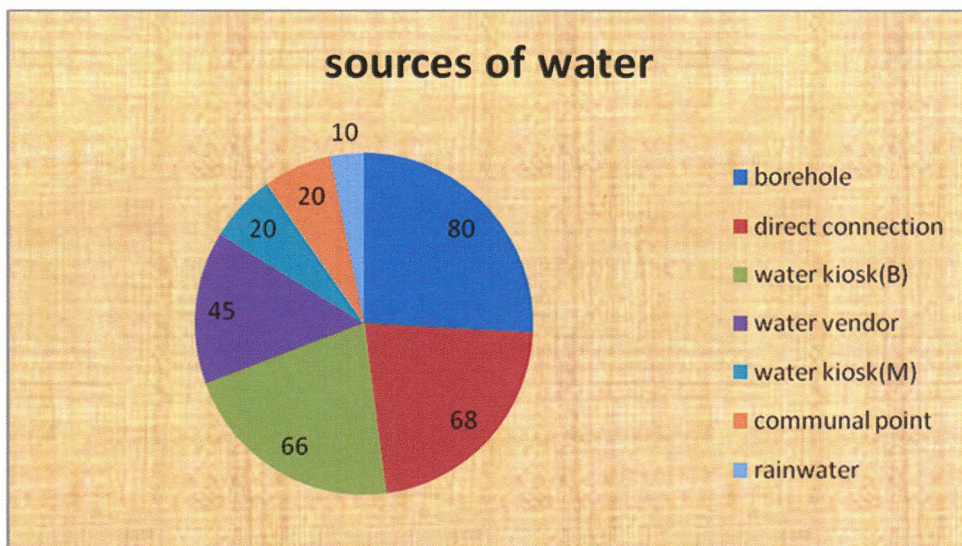


Figure 5.1: Water Sources in Ruiru Municipality

Source: Field data (2009)

5.1.2 Water Demand

The population served by RUJWASCO is approximately 60,000 people against a large population in the area approximating at 160,000 people. The total demand for water and sewerage services is 24,000m³ per day and 16,000m³ per day respectively. This is so given that there are 310 people per km². The total water supplied by RUJWASCO is 700m³ per day living a large deficit of the population not served. This amount is about one-third of the total amount required. The current amount of water supplied falls short of the recommended amount per person per day, which is 50litres compared to 20 litres per person per day supplied by RUJWASCO. However, there are other means by which both the water company and the community are utilizing in order to reduce the water

deficit. These include obtaining water from underground sources (boreholes) and buying water from other service providers for example, from Nairobi Water and Sewerage Company (NWSC).



Plate 5.2: Ruiru water supply treatment facility

Source: Field data (2009)

5.1.3 DOMESTIC AND INDUSTRIAL USES

These are the basic usages of drinking, food preparation, domestic hygiene and the collective usages at the household level. Per capita levels of domestic use increase as general levels of well-being and aspirations rise; in addition demographic factors contribute heavily to shape water requirements in this sector.

Basic needs in domestic water supply can be met by the regular and reliable provisions between 30 and 50 litres per capita per day (lcd) of water of adequate quality for drinking, food preparation and personal and domestic hygiene. Such level of water consumption is considered adequate for effective control of water-based diseases. In

Ruiru Municipality, a large proportion of the population is not supplied with the minimal quantity of water, and as a result, water washed diseases have a high incident and sometimes cause death, most notably in low-income areas.

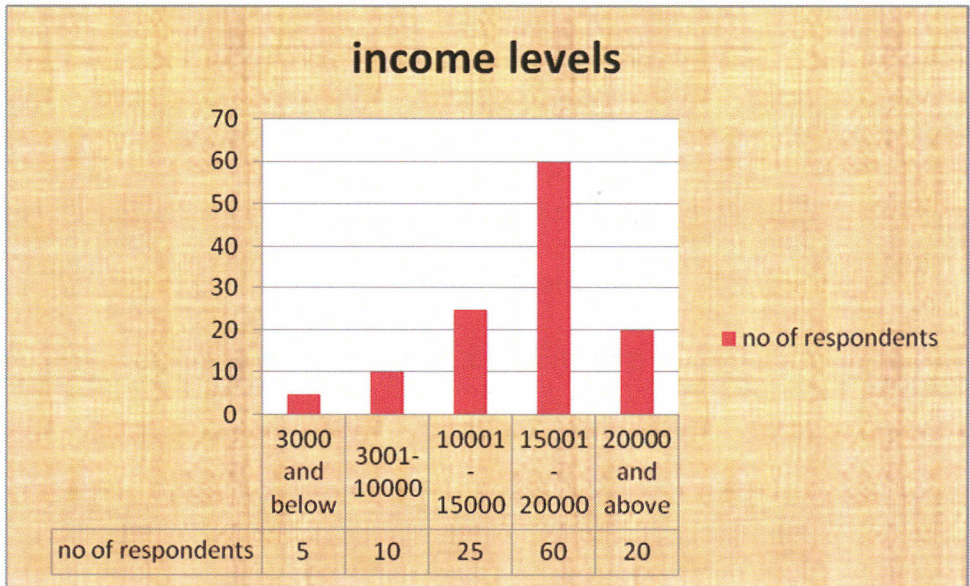


Figure 5.2: Household Income Levels

Source: Field data (2009)

Industrial production is dependent on water for processing, cooling and evacuation of effluents. However, in Ruiru Municipality, many industries rely on boreholes to meet their industrial water requirements and are only supplied by Ruiru water supply only when they experience a technical problem.

5.2 FACTORS CONTRIBUTING TO UNACCOUNTED-FOR WATER WITHIN RUIRU MUNICIPALITY

5.2.1 Unaccounted-for-water

Unaccounted-for water in any given Municipality should be as low as possible since the water wasted can go a long way in extending the supplies to un-served areas. Reducing this unaccounted-for water also increases revenue base for the water supplying company thus better management of the existing distribution system. According to RUJWASCO, the unaccounted-for water in Ruiru Municipality averages at 40%. This figure is relatively high bearing in the mind the limitations to availability of water in the area. The company does not operate to its capacity, and then 40% of the 700m³ of water produced daily is lost.

5.2.2 Factors Contributing to Unaccounted-for water

There are many factors that contribute to unaccounted-for water in Ruiru Municipality as found out from the study. One is the water lost through leakages from pipes, meters and pumps. Leakages in a distribution system are difficult to control as the pipes are buried in the ground and it takes a while before they are detected. Leaks occur mainly in case of old and dilapidated distribution system, poor installation techniques of water equipments and also due to excess pressure of pumping water. Because leakage losses are usually such a large proportion of total UFW, leakage detection and repair need to be given high priority, since they are capable of saving much water which can then be used for such purposes as augmenting existing supplies.

Another cause of water loss is the pipe bursts. Pipe bursts may occur due to high water pressure within the pipes, vandalism, heavy machineries and vehicles, farmers when tilling the land, old pipes. Around Ruiru town, vandalism and heavy transportation

vehicles commonly cause pipe bursts. The distribution system currently existing in the Municipality is old and dilapidated and this has contributed to frequent pipe bursts compounding the problem of water loss. In areas where farming is done, land preparation tractors and other farming tools commonly cause bursts. There are also reported cases where farmers burst the pipes intentionally so that they can use the water for irrigation purposes especially at night. It is worth to note that there are also undetected pipe bursts that lose a lot of water since the time of response is prolonged.



Plate 5.3: Frequent pipe bursts

Source: Field data (2009)

Illegal water connections though are the main cause of unaccounted-for water in the Municipality. This is most common in Ruiru town where small business enterprises are emerging and they do not want to pay for water services. So they just connect water from the water company mains, or from the nearby houses that are metered. This is because the houses pay the minimum water bills despite the amount of water consumed according to

the flat rate billing system. This water is mostly used for car washing and for irrigating the landscaping plants found along the roads. Apart from business enterprises, many households are connecting water illegally and especially after the water have been disconnected for non-payment. Instead of paying the water bills, the house owner's just connect water for themselves without the knowledge of the water company staff.



Plate 5.4: Illegal Water Connections

Source: Field data (2009)

Most households and small enterprises in the Municipality fall under the flat billing system. This is the system where the consumer pays the minimum wage for the water services. It is assumed that every consumer uses around 10m^3 of water per month that is charged 200 shillings per month. This assumption has led to increased unaccounted-for water since it is known that many consumers use more amounts that what do the water providers estimate especially by the small-scale enterprises and the middle and upper income classes. Since the water company can only account for the 10m^3 used, the remaining amount no matter how large is lost.

Faulty and un-calibrated meters also contribute significantly to amount of water unaccounted-for. Meters become faulty due to aging factors tampering with metering devices by the consumers. In many cases, consumers alter their meter readings so that they pay less amount of money as compared to the amount of water consumed. After some time, meters also require calibration although they have not been tampered with. If proper calibration is not done, meter readings will not reflect the true amount of water consumed. Metering of domestic water can be used to conserve water, since it places a financial incentive on consumers to reduce consumption. Studies have shown that metered consumptions is significantly less, often up to 30%, less than un-metered consumptions. Metering is especially effective when used in a combination with sliding scale tariff structure which severely penalizes excessive consumptions. In Ruiru Municipality, little is known of the degree to which metering reduce water consumption.

Since there are many private water providers in the area, sometimes companies's water get mixed with their water leading to the company's loss. This is so especially in the upper areas supplied by NWSC since they still use the old distribution system. Sometimes, private water vendors who have their own boreholes connect the company's water to their vending points and the water supply company cannot tell whether it is their water being sold. These factors can be summarized as shown in figure 5.2.

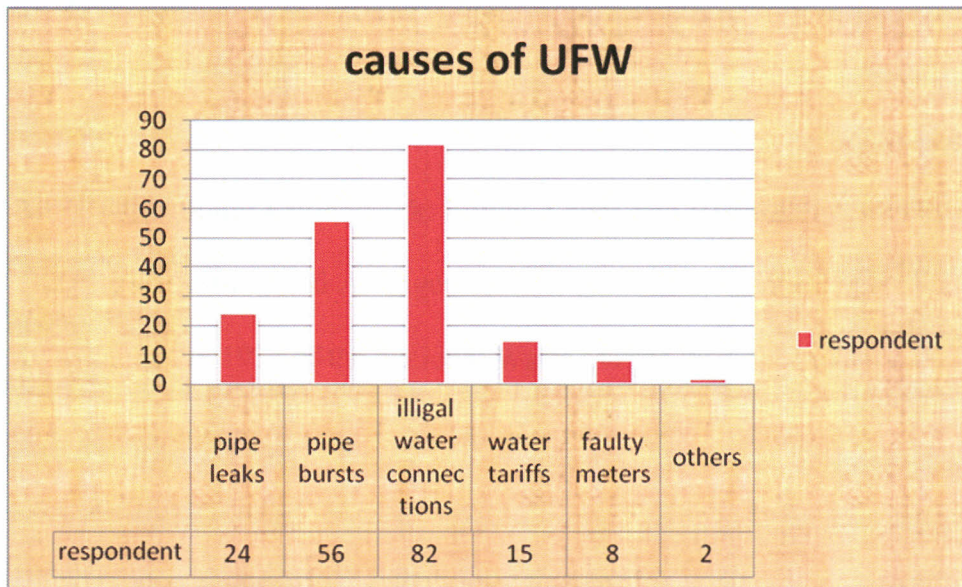


Figure 5.3: Factors contributing to UFW

Source: Field data (2009)

5.2.3 Benefits of Managing Unaccounted-for water

There are many reasons as to why a water supply company would want to reduce the amount of water unaccounted-for. These benefits mostly are associated with saving the scarce resource and increasing revenue base for the supplying company. For instance, reducing unaccounted-for water reduces demand on scarce water supplies and minimizes the need to develop additional water supply. Traditionally, demand for water has been met by sourcing for additional supply systems instead of managing water demands so as to extend supply to more areas. Minimizing water loss has other beneficial attributes such as increasing the revenue collected for water services offered and by reducing the pumping and treatment costs. Managing water loss also reduces property damage through improved maintenance and thus increases the durability of the distribution system.

5.3 INSTITUTIONAL ARRANGEMENTS FOR WATER SUPPLY AND DEMAND MANAGEMENT IN RUIRU MUNICIPALITY

5.3.1 Institutional Framework: Policy, Legal and Regulatory Structures

The present Institutional Arrangements for the management of water sector can be traced to the launch in 1974 of the National Water Master Plan, the primary aim of which was to ensure availability of potable water, at a reasonable distances, to all households by the year 2000 (Sessional Paper No. 1 of 1999). The plan aimed to achieve this objective by actively developing water supply systems, which required the government to directly provide water services to consumers, in addition to its other roles of making policy, regulating the use of water resources and financing activities in the water sector. The legal framework for carrying out these functions was found in the prevailing, The Water Act, Chapter 372 of the Laws of Kenya, which had been enacted as a law in the colonial era.

In line with the Master Plan, the government upgraded the Department of Water Development (DWD) of the Ministry of Water. The DWD, which continued to exist as a department in the newly created ministry, embarked on an ambitious water supply development programme. In 1988, the government established the National Water Conservation and Pipeline Corporation (NWCPC) as a state corporation under the States Corporation Act, Chapter 446 of the Laws of Kenya, to take over the management of government operated water supply systems that could be run on a commercial basis. Alongside DWD and the NWCPC the large municipalities were appointed as 'water

undertakers'. A water undertaker-ship was the term given to the license issued under the Water Act, to supply water within the area.

Additionally people were receiving some level of service from the systems operated by the self-help (community) groups that had built the systems, often with funding from the donor organizations and the technical support from the district officials of the DWD (Government of Kenya, 1999). Persons not served by any of the above arrangements did not have a systematic water service. They had to rely on such supply, as they were able to provide for themselves, typically by direct collecting water from a watercourse or from other water source on daily basis. Indeed, despite the government ambitious water supply development programme, by 2000 less than half the rural population had access to portable water; in urban areas only two-thirds of the population had access to potable wand reliable water supplies.

In the 1980s, the government began experiencing budgetary constraints and it became clear that, on its own, it could not deliver water to all Kenyans by the year 2000. Attention therefore turned to finding ways of involving others in the provision of water services in place of the government, a process that came to be known popularly as 'handing over'. In 1997, the government published manual giving guidelines on handing over of rural water supply systems to communities (Ministry of Land Reclamation, Regional and Water Development, 1997). The manual stated criteria for handing over to be the capacity of the community to take over, the ability to pay, the capacity to operate

and maintain the system, the involvement of the women in management, and the ability and the willingness to form community based groups with legal status.

Building on this experience, the government developed a fully-fledged policy. The National Water Policy, which was adopted by the parliament as Sessional Paper No.1 of 1999, the development of the National Water Policy, was largely funded by the donor organizations whose predominant interests was with regard to domestic water supply, and not with irrigated agriculture or even with water resources management. Key among these donors was GTZ-interested primarily in urban water supply, SIDA-interested largely on rural domestic water supply and the World Bank.

The National Water Policy stated that the government's role would be redefined away from direct service provision to regulatory functions: service provision would be left to municipalities, the private sector and the communities. The policy also stated that the Water Act would be reviewed and updated, attention being paid to the transfer of water facilities. Regulations would be introduced to give other institutions the legal mandate to provide both water services and mechanisms for regulations. The policy justified the handing over, arguing that the ownership of a water facility encourages proper operation and maintenance: facilities should therefore be handed over to those responsible for their operation and maintenance. The policy stated that the government would hand over urban water systems to autonomous departments within the Local Authorities and rural water supply to communities.

While developing the National Water Taskforce the government also established a National Task force to review the Water Act, and draft a bill to replace the Water Act. The water bill 2002 was published on 15 March 2002 and passed by the parliament on 18 July 2002. It was gazette in October 2002 as the Water Act, 2002 and came into effect in 2003, when effective implementation of its provisions commenced.

5.3.2 THE REFORMS OF THE WATER ACT, 2002: THE NEW WATER ACT

The Water Act, 2002 has introduced comprehensive and, in many instances, radical changes to the legal framework for the management of the water sector in Kenya. These reforms revolve around the following four themes:

- i. The separation of the management of the water resources from the provision of water services
- ii. The separation of policy making from day-to-day administration and regulation
- iii. Decentralization of the functions to lower level state organs
- iv. And the involvement of non-governmental entities in both the management of the water resources and the provision of water resources. The institutional framework resulting from these reforms is represented diagrammatically as shown.

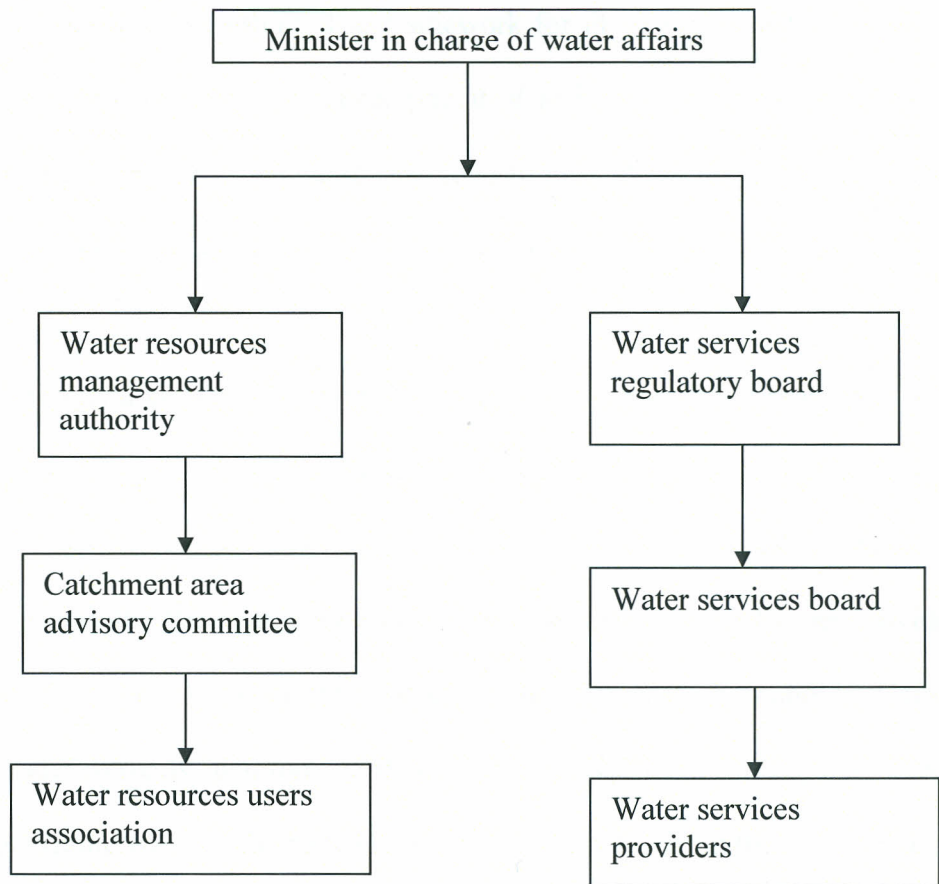


Figure 5.4: Diagrammatic representation of the new institutional structure for the management of water affairs in Kenya

5.3.3 Separation of Functions

The Water Act separates water resource management from the delivery of the water service. It establishes the two autonomous public agencies; one to regulate the management of the water resources and the other to regulate the provision of water and sewerage services.

The Act divests the Minister in charge of water affairs of regulatory functions over the management of water resources. This becomes the mandate of the new institution, the Water Resources Management Authority (the Authority), established in section 7 of the Act. The authority is responsible for, among other things, the allocation of water

resources through permit system. The framework for the exercise of the water resource allocation function comprises the development of national and regional water resources and management strategies, which are intended to outline the principles, objectives and procedures for the management of the water resources.

Similarly, the Act divests the Minister in charge of water affairs of regulatory functions over the provision of water and sewerage services and vests this function in another public body, the Water Services Regulatory Board(the Regulatory Board), which is created in section 46. The regulatory board is mandated to license all water providers and sewerage services that supply water services to more than 20 households. Community managed water systems therefore need to obtain license from the regulatory board to continue providing water to their members. This is departure from the practice previously prevailing under which community water systems, unlike the other systems, operated without a license.

5.3.4 DECENTRALIZATION OF FUNCTIONS

The Water Act, 2002 decentralizes the functions to lower level public institutions. It does not however, go as far as to devolve these functions to the lower level entities. Ultimate making decisions remain centralized.

With this regard to water resources management, section 14 of the Act provides that the Authority may designate catchment areas as areas from which rainwater flows into a water course, as they are so defined. The regulatory functions over water resources management, currently performed by the district offices of the ministry in charge of water affairs are, supposedly, under the new legal framework, to be transferred to the catchment area offices of the authority.

With regard to the provision of water and sewerage services, section 51 of the Act establishes Water Services Boards (WSBs), whose area of service may encompass the area of jurisdiction of one or more Local Authorities. A WSB is responsible for the provision of water and sewerage services within its area coverage and, for this purpose; it must obtain a license from the regulatory board. The WSB is prohibited by the act from engaging in direct service provision. The board must identify another entity, a water services provider (WSP), to provide water services, as its agent. The law allows WSBs, however, to provide water services directly in situations where it has not been possible to identify a water service provider who is able and willing to provide the water services. WSBs are regional institutions. Their service areas have been demarcated to coincide largely with boundaries for catchment areas. The table 5.2 summarizes the different institutions in water sector as stipulated in the Water Act of 2002 and their specific roles and responsibility in water provision and management sector in Kenya.

Table 5.2: Institutions in water sector and their roles (Water Act, 2002)

Institution	Roles and responsibilities
Ministry of Water and Irrigation (MWI)	<ul style="list-style-type: none"> • Development of legislation, policy and strategy formulation, sector coordination and guidance, and monitoring and evaluation • Overall sector investments planning and resource mobilization
Water Services Regulatory Board (WASREB)	<ul style="list-style-type: none"> • Regulation and monitoring of service provision (Water Services Boards and Providers) • Issuing of licenses to Water Services Boards • Setting standards for provision of water services • Developing guidelines (water tariffs etc.)
Water Services Boards (WSBs)	<ul style="list-style-type: none"> • Efficient and economical provision of water services • Developing water and sewer facilities, investment planning and implementation • Rehabilitation and replacement of infrastructure • Applying regulations on water services and tariffs • Procuring and leasing water and sewerage facilities • Contracting Water Service Providers (WSPs)
Water Service Providers (WSPs)	<ul style="list-style-type: none"> • Provision of water and sanitation services, ensuring good customer relation and sensitization, adequate maintenance of assets and reaching a performance level set by regulation
Water Services Trust Fund (WSTF)	<ul style="list-style-type: none"> • Financing provision of water and sanitation to disadvantaged groups (pro-poor) as water poverty fund
The Water Appeals Board (WAB)	<ul style="list-style-type: none"> • Arbitration of water related disputes and conflicts between institutions and organizations
National Water Conservation and Pipeline Corporation (NWCPC)	<ul style="list-style-type: none"> • Construction of dams and drilling of boreholes
Kenya Water Institute (KEWI)	<ul style="list-style-type: none"> • Training and research

5.3.5 Ruiru-Juja Water and Sewerage Company Limited (RUJWASCO)

The vision of RUJWASCO is to be a world-class provider of water and sewerage services. Their mission is to provide quality and reliable water and sewerage services by embracing high standards of professionalism and integrity in their service delivery. Their core values include: focus on customer service, integrity, and efficiency in management of all resources, passion for excellence, embracing teamwork, continuous capacity building and high standards of corporate social responsibilities.

Ruiru-Juja water Sewerage Company limited was formed in March 2006 to provide water and sewerage services to the residents of Ruiru and Juja. It was operationalised in October 2006. The company is registered under the Companies Act (Cap 486). RUJWASCO is a joint venture between the Municipal Council of Ruiru and County Council of Thika, who own the company on 50-50 basis. It serves the whole area under Municipal Council of Ruiru and areas of Juja that falls under the County Council of Thika.

The registered office of the company is in Ruiru town in Thika District, 16 Km from the centre of Nairobi and 18 Km from Thika town. Nairobi has been growing at an average rate of 7.3% per year, and one of the solution people find to serve problems of service provision in the capital is to live in satellite towns like Ruiru. While this helps in relieving the housing crisis in the capital, the growing population has put enormous pressure on the services offered by Ruiru Municipality, one of the services being water and sewerage services. Without improvement in these services, Ruiru Municipality faces

increasing problems of diseases, environmental degradation and inevitable decline in quality of life.



Plate 5.5: RUJWASCO Offices

Source: Field data (2009)

RUJWASCO jurisdiction extends from Githurai to Witeithie settlements scheme and spanning about three kilometers astride Thika road. Considering that the services in the areas are archaic poorly designed and run down, the tasks and the responsibilities imposed on RUJWASCO are enormous. To deliver good services, the system requires a full overhaul. The sewerage systems are non-existent in both Ruiru and Juja. The Ruiru River source and its intake works was constructed in 1950; while the Juja scheme was built in 1983. Both the schemes were built to serve a considerable smaller population than is the case today. As a result, water shortage in both Ruiru and Juja are common as the current infrastructure cannot cope with the ever arising demand.

5.3.6 Constraints Faced by RUJWASCO in Water Supply and demand

Management

According to RUJWASCO, there are many constraints to sustainable water supply and demand management in Ruiru Municipality. If these constraints are not taken care of or improved, the residents feel that water supply in the area will continue to pose a big challenge to the water supply company. These constraints are summarized in figure 5.5.

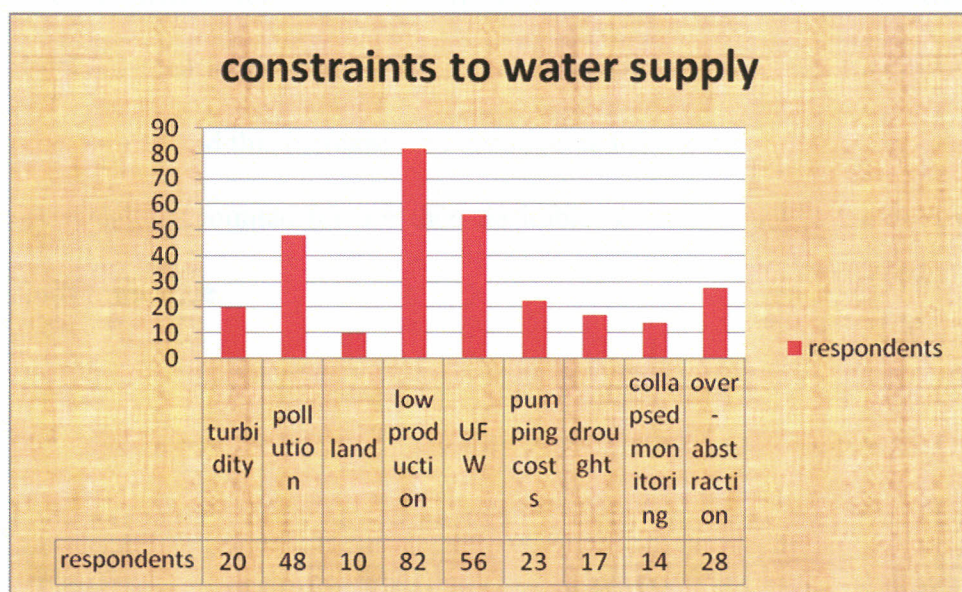


Figure 5.5: Constraints to Sustainable Water Supply and Demand Management

Source: Field data (2009)

The major problem is inadequate water production to meet the current increased demand of water in the area. There is inadequate capacity of treatment systems: initially the systems treated about 20m³ of water per hour but this has reduced to 10m³ due to ageing of the infrastructures and reduced River water levels that reduce the gravity at the water intake point. The company already does not operate at its full capacity which was designed at 1000m³ per day, but even if this amount was to be met, the demand for water

greatly outweighs the production. This in turn has led to low water supply coverage in the Municipality and deliberate measures should be taken to increase water production by improving infrastructure and implementing water demand management strategies.

The presence of high unaccounted-for water in the Municipality is another constraint to water supply. The little water produced is then lost or unaccounted-for and if it was reduced, then water could be available more to the consumers and increase the area of coverage. There are regular bursts and blockages of the pipes caused by vandalisms or other causes and this increases the unaccounted-for water. Measures to reduce the amount of water unaccounted-for are then desirable so as to manage water sustainably and to recover revenue.

Increased water pollution is another constraint to water supply in the Municipality. Pollution mainly originates from the industries found in the area which dumps their effluents directly to Ruiru River and especially from the coffee industries upstream that discharges their raw wastes directly to the River. Water pollution also occurs as a result of human activities such as bathing, washing and swimming in Ruiru River by the larger population un-served by tap water. Lack of conventional sewerage system is the main contributor to water pollution since they lack proper waste disposal.

Another constraint is high turbidity of raw water, that is, water changing colour and containing suspended particles especially during the rainy seasons. High turbidity increases the cost of water treatment and if these costs are not recovered through revenue

collection can put the company in financial crisis and further complicate water supply services.



Plate 5.6: Water Turbidity in Ruiru River

Source: Field data (2009)

Over-abstraction of both surface and groundwater is a major constraint. It is evident that many individuals, groups or industries acquire their water from the boreholes. The use of this water is not restricted and depends on the capacity of the borehole to produce water. This has led to increased water wastage as many draw water excessively even when it is not needed. This can lead to over abstraction of ground water and in turn reduces the replenishment capacity of the Rivers. Thus ground water use should be regulated as a means of conserving water and also to reduce underground water pollution.

Collapsed water resource monitoring network has led to catchment degradation, which in turn has its effect on quality and quantity of water available for use. For example, cultivation along the River riparian has significantly increased the turbidity of the water

and also to drying up of the springs, which replenishes the River capacity. If proper monitoring and enforcement of the stipulated regulations in relation to water catchment areas is done, then the problem of water levels reducing in the Rivers will be solved and in turn increase the supply of water to consumers both served and un-served.

During drought season, the water level in Ruiru River that is the main source of water and from where the company has built its intake reduces. This means that the water in treatment tanks reduces since it flows by gravity from the River to the tanks and if the volume of water in the River reduces, the pressure in turn reduces and little water gets into the treatment tanks. Thus during the drought season, the water scarcity in the area is aggravated often leading to long hours of rationing.



Plate 5.7: Reduced water levels in Ruiru River

Source: Field data (2009)

Inadequate public land set aside for infrastructural development is another constraint to water supply. The land where the current water intake is built is too small to

accommodate any further expansion. Thus land is already scarce witnessed by people farming along the River riparian's and wetlands along Ruiru River and thus governments and land institutions should tackle the issues of availability of public land for development.

The company is faced with low financial capital base since it was formed recently (2006) and it is not properly established to carry the enormous responsibilities of water services that it is supposed to carry. Revenue collection from the services it offers is very low as the mechanisms for collecting revenues are not yet revised and this affects the area of coverage for water supply in the area.

Lack of sewerage treatment plant in the Municipality is the biggest challenge. Initially, the population was small and was well served with septic tanks for liquid waste disposal. However, population has since increased and the increased use of septic tanks is discouraged as it leads to contamination of underground water, which is heavily relied upon by the residents. This has necessitated the need for sewer construction, though without the help of government or the donors, this task will take time since the company is not in a position to fund the construction alone.



Figure5.8: Lack of Sewerage System

The state of water infrastructure in the area is so poor. The infrastructures are dilapidated and in some case rendered out of use due to ageing and physical damage. This has posed the greatest challenge to water supply in the Municipality as their repair and maintenance is too expensive. As a result, the distribution system requires a complete overhaul for efficient water supply. Infrastructural development is requires do as to extend water coverage to the vast un-served areas of the Municipality.

Acquisition of donors to fund water supply projects in the areas is another problem. This leaves the company to rely solely on the government to finance their projects which finances through CDF initiatives but its barely enough considering the acute water

shortages in the area. AWSB also sometimes offers financial support or donated equipments such as pipes but this is barely enough to meet the needs of the company.

The company also has inadequate members of staff. The staff lacks capacity both in terms of the number and the technical skills needed to manage water problems in the area. Many technicians lack adequate computer skills, which can greatly improve service provision and data keeping. The lack of capacity is also contributed by the fact that the company is very young and it has not established well to attract qualified personnel.

The company also lags behind in terms of technology advancement. This is evident as they still use the outdated methods of water billing like the flat rate system since they don't have equipments and technology required to bill each individual water consumer in the area. Also the company does not bill its consumers itself but instead they contract an IT company to bill for them. This is because they lack the human resource knowledge as well as computer equipments to do so. The company does not have any technology to help them detect water bursts and leakages and they rely purely on zonal managers to track and report the leakages.

5.3.7 Opportunities for RUJWASCO in Attaining Sustainable Water Supply and Demand Management in Ruiru Municipality

The company felt that there are many opportunities for sustainable water supply that if exploited, can assist in reducing the current acute water shortage in Ruiru Municipality.

These opportunities are as follows:

- Construction of new water intake works; the company felt that there is need to construct a new water intake facility. It is evident that the current water works and treatment facilities cannot supply water to the rapidly increased consumers since it was initially designed for fewer consumers. Increase population in Ruiru Municipality has exerted enormous pressure on water supply systems and thus construction of new water works will be the most preferred solution to deal with acute water shortages in the area.
- Rehabilitation of existing water supply system; as found out from the field study, there is need to rehabilitate the current water distribution system as it was laid down long time ago (1956) and it has consequently been dilapidated to appoint that it can no longer provide efficient water supply to the entire population that depend on it.
- Exploitation of ground water: it was evident that it is not enough to rely only on surface water (Ruiru River) which is affected by drought seasons to extent that pressure is reduced and the level of water in treatment tanks consequently reduces significantly. Therefore, the company felt that exploitation of groundwater is an alternative source that can increase the amount of water available for distribution.
- Water resource management; one of the major problem in Ruiru is increase pollution of Ruiru River from existing industries which channels their effluents in to Ruiru River. This increases time required for water treatment and costs of treatment. Implementing water resource management by the relevant authorities will improve

the level of water supply in the area by protecting the water sources therefore reducing turbidity and water pollution.

- Water conservation measures; implementing water conservation measures both at household and industrial levels could significantly reduce the water consumption rates and water will therefore be available to extend to un-served areas. Measures such as using water conservation devices in houses especially in bathrooms (shower heads) and flushing toilets can save water significantly. Recycling water in industries could reduce the amount supplied to them thus conserving water.
- Rainwater harvesting technologies; rainwater can be an alternative source of water in the area, which can be exploited at minimal cost for domestic, livestock and agricultural activities. However, the company argued that there is little awareness of benefits associated with rainwater harvesting and felt that public awareness and education should be done to educate people on how to harvest rainwater for future uses.
- Investment in water supply sector; sufficient investment in water supply sector should be the priority for the Municipality. Investment is needed in many areas such as construction of new underground storage tanks to increase volume of water available for supply. Also, in extending pipelines to the areas currently not served by the water pipelines. Investing in durable although expensive water equipments such as pipes

and pumps can reduce the costs of maintenance and reduce the problem of water loss in the distribution system.

Other opportunities as mentioned by the respondents include;

- Land administration and survey to set aside land for extending the existing water intake works for construction of a new intake plant
- Making the residents understand the contents of the new water act, and their roles and responsibilities as indicated in the act
- Encourage research and development in the area to provide data on investment opportunities available in the Municipality and also to advice and encourage the communities on efficient utilization of available natural resources.
- Adopting participatory approach by involving the consumers and the relevant institutions in major decision making processes concerning water and its availability in the area and how to conserve water
- Partnering with other water service providers to increase the volume of water available to supply to un-served areas, for example, NWSC and Thika Municipality

5.4 PROPOSED MATRIX PLAN FOR SUSTAINABLE WATER SUPPLY AND DEMAND MANAGEMENT FOR RUIRU MUNICIPALITY

5.4.1: Matrix Plan

With the aim of attaining sustainable water supply and demand management in Ruiru Municipality the following strategies, activities, and actors are proposed (table5.1).

Table 5.4: Plan matrix for Sustainable Water Supply and Demand Management for Ruiru Municipality

Issues	Current measures	Proposed measures	Responsibilities	Timeframe			Follow up measures
				ST	MT	LT	
Provide an efficient water supply	Repair of current piping system	Replace the existing supply system with new ones	AWSB RUJWASCO Ministry of Water & Irrigation Donors	✓	✓	✓	Site inspection Field reports
Increase production of water to meet the current demand	Rehabilitation of the existing water works in Ruiru Rehabilitation of boreholes Buying water from other water providers Sink new wells and boreholes	Augmenting water supply by Constructing new intake work Conduct feasibility study and design intake source from Ruiru River Exploitation of ground water Seek funds from donors and LATF	RUJWASCO AWSB Ministry of Water & Irrigation Physical Planning Department LATF CDF Private water providers Self help groups Donors	✓	✓	✓	Site inspection EIA Monitoring and evaluation Auditing
Improve water supply	Rationing programmes Mobile water trucks to uncovered areas Boost storage and extension Rehabilitating the current storage tanks	Increase number of consumers served Extension of pipelines Lay piped twin line Installation of pipes to uncovered areas Put up distribution network and water kiosks Install new pumping sets to areas not covered Construct ground masonry	AWSB RUJWASCO Donors Ministry of Water & Irrigation Ministry of Land Ministry of Local Government CDF LATF	✓		✓	Site inspection Monitoring Field reports

		storage tank					
Reduce cost of pumping	Reducing the hours of pumping	Installation of solar generators to lower the costs of pumping Investigate the possibility of installing gravity system Construction of elevated storage tank Replace pumps with current power efficient ones	RUJWASCO CDF LATF Ministry of lands (survey department)	✓		✓	Monitoring and evaluation of the installed solar system
Install sewage systems	Use of septic tanks	Planning and designing of sewerage system Put up sewerage system Create an enabling environment for residents and investors	Ministry of Planning (Physical Planning Department) Ministry of Water & Irrigation Ministry of Environment & Natural Resources (NEMA) Ministry of Finance AWSB RUJWASCO Donors Ruiru Municipality Relevant institutions and NGO's			✓	EIA Auditing, monitoring and evaluation
Reduce unaccounted-for water	Patrolling the area to curb illegal water connections Repairing of pipe leaks and bursts	Installation of devices such as metering devices and valves Rules and regulations against illegal water connections Review of water tariffs to reflect the current situations Install relevant valves	RUJWASCO Consumers Ministry of Water & Irrigation	✓	✓	✓	Field inspection Monitoring

		Install all necessary fittings and water valves for road and River crossings					
Water resource management	Observing the riparian strip Monitoring industries effluents into the River system	Strict measures on releasing effluents into Ruiru River Implementing polluter pays principle More active involvement of water resource management authority Implementation and enforcement of rules and regulations against water pollution Conserving water catchment area	WRMA RUJWASCO Industries Consumers Ministry of Water & Irrigation Ministry of Environment & Natural Resources (NEMA) Ruiru Municipality Water Users Associations	✓	✓	✓	Auditing, monitoring and evaluation of industries adherence to EMP
Promote and encourage Water conservation	Water rationing	Encourage Rain water harvesting for domestic and livestock use Implementing rules and regulations on water conservation e.g. installation of water saving devices during housing construction Creating awareness and sensitization of public on importance of water conservation Revise water tariffs to penalize excessive use Encourage water recycling for landscaping and kitchen	Ministry of Education Ministry of Water & Irrigation Ministry of Environment & Natural Resources Ministry of Housing RUJWASCO WRMA	✓	✓	✓	Monitoring Evaluation Field reports

		gardening Review education syllabus to cover water conservation issues					
Operationalization of new water act	Creation of water supply company	Public participation in prioritizing water issues Public awareness of their roles and responsibility under the current water act Forming the water users association to represent the resident in water boards	Ministry of Water & Irrigation AWSB RUJWASCO Media	✓		✓	Evaluating responsible bodies
Land administration and human settlement	Destruction of structures near to water sources	Setting aside land for extensions of current treatment work Planning of settlements to protect water sources from being encroached	Ministry of Land Ministry of Housing Ruiru municipality Ministry of Environment & Natural Resources RUJWASCO	✓		✓	Monitoring Field reports of settlement patterns
Research and development	Creating awareness to the public of existing of the water company	Document and provide data on investment opportunities available in Municipality Advice and encourage the communities on efficient utilization of available water resources	KIRDI Universities Ministry of Water & Irrigation RUJWASCO AWSB		✓	✓	Evaluating and monitoring the relevant institutions
Capacity building	Organizing seminars and field trips for the works so as to learn how other water service providers are dealing with their challenges	Hiring of qualified staff to deal with water planning issues Introduce short courses to improve the capacity of the workers Source for funds so as to attract professionals	RUJWASCO AWSB	✓	✓	✓	Monitoring and evaluation

CHAPTER SIX

SUMMARY OF THE FINDINGS, CONCLUSION AND RECOMMENDATIONS

6.1 SUMMARY OF THE FINDINGS

The study found out that the Ruiru Municipality faces acute water shortage. Water supply is quite low approximately one third of the total demand of water per day. The supply of water was 700m³ per day while the demand was 24,000m³ per day. Apart from that amount supplied by the water company, residents tried to cover the remaining deficit by fetching water directly from Ruiru River, digging wells and boreholes, buying from water vendors and other private water suppliers and even by forming community water self groups with help from CDF.

The study showed that the amount of water unaccounted-for in Ruiru Municipality averages at 40%. This figure is quite high given the acute water shortage in the area. Factors contributing to high unaccounted-for water levels include leaks from the pipes, meters and pumps, pipe bursts, illegal water connections, faulty and uncalibrated meters, the current water tariff structure, water mixing with that of private providers and old and dilapidated distribution system. These factors have singly and/or collectively have contributed to water shortage in the area as they have led to loss of little treated water available for supply.

The evaluation of the existing policy framework presents both strengths and weaknesses. The government has shown its commitment to improve the performance of the water

sector and particularly water supply and water resource management through delegating and decentralizing the functions to relevant authorities and institutions. However the sector has suffered a setback due to some reasons which include; lack of funds to newly found water services authorities to fund water development programmes; lack of funds by the newly formed water service providers, for instance, RUJWASCO, to extend the water supply to un-served areas and also to maintain the existing facilities, lack of enforcement power by water resource management authority to prosecute the offenders, the government also implemented the reforms in the water sector through a sectoral approach. The study also came up with water supply and demand management plan, which could promote sustainable water supply and demand management to ease water shortages in the area.

6.2 CONCLUSION

The study outlined a number of challenges hindering sustainable water supply and demand management in Ruiru Municipality. These challenges include; high demand of water than supply, development of the sewerage systems, collection of the arrears, dealing with pollution of water sources, reduction of the unaccounted-for water, improving the existing water systems, sustainability in water resources management, and dealing with encroachment and destruction of water catchment areas. These challenges have had negative implications on the performance of the water service provider (RUJWASCO). The study further identified opportunities that could be explored to promote sustainable water supply and demand management inform of a matrix plan. These were identified as rehabilitation of existing water supply system, exploitation of the groundwater, water resource management, construction of new water supply systems,

adopting water conservation measures, making the new water act fully operational, land administration survey and settlement and adoption of research and development opportunities.

6.3 RECOMMENDATIONS

The revealed some opportunities for sustainable water supply and demand management.

But to fully achieve this, the respondents said that the following recommendations have to be met either immediately, in short-term or in long run.

6.3.1 Short-term Recommendations

- Various institutions mandated with policy formulations should adopt bottom up decision-making processes by embracing public participation in planning issues. The water service providers should involve residents in investment issues so that areas of priorities according to the consumers are dealt with first.
- One of the flaws in the existing Institutional Arrangement has been an attempt by the Ministries of Water and Local Authorities to create capacity in the national level to deal with the enforcement problems at the local level instead of mandating the Local Authorities to create the necessary capacity at the local level to handle the emerging water problems. As a rule, national governments should not implement tasks that can be done more efficiently or effectively at lower government levels, although they should ensure that these tasks are executed.
- There are no mechanisms for penalizing illegal or unlicensed groundwater use. This can explain why the reluctance among the industries and other consumers to install meters on surface and ground water usage. Thus the relevant authorities should formulate rules and regulations to implement the penalties to illegal or unlicensed water use.

- Improve coverage of waters supply in the area by increasing the area of coverage of piped water supply. Water pipelines should be extended to un-served areas. Appropriate investment programmes should be drawn and they should give priority to the areas worsely affected by water supply.
- Water resource management authority should take an active role in protecting water resources in the area by prosecuting industries believed to contribute to water pollution by releasing industrial wastes in to the River system. Also, it should protect water catchment area from destruction through encroaching the catchment area for settlement or agricultural purposes.
- Reduce the amount of unaccounted-for water to an acceptable level by implementing proper management of the distribution system. Quick measures to detect pipe bursts when they occur should be put in place by adopting the current technology like using listening devices. Durable equipments should be used when replacing the used ones so as to reduce maintenance costs.
- Reduce the distance to near water points by increasing the number of water kiosks in the areas not served by piped water. This will increase the coverage of water in the area and save time for women and children who travel far in search of safe drinking water.
- Public education to the residents should be done to create awareness on water issues and to inform the resident on ways of conserving water at household level. Also to create awareness on risks associated with destruction of water catchment areas.

- The water company should improve revenue collection for water services provided to the residents to secure funds to extend service to un-served areas and for proper maintenance of the existing water facilities.

6.3.2 Long-term Recommendations

- The main problem arising from the existing Institutional Arrangement is that the Ministries of Water and Irrigation and to some extent Ministry of Local Government has maintained the sanctity of certain regulatory functions on water management. These functions that include ground and surface water management and water tariff approvals have been maintained even when the tasks exceed the capacity of these ministries to deal with. For example, the existing ground/surface management approach assumes a highly simplicity, centralized approach to water allocation problem, and ignores the possibility of a decentralized and localized management options by Local Authorities. If the Local Authorities could be mandated to regulate groundwater and surface water access then these can be regularized within the existing structures and suitable framework for pricing and regulation determined
- A broader framework for water pricing is needed. Such a framework entailing first tier pricing, in which water as a resource is priced, could ensure that all water resources whether public, surface or ground water have a first price for all users. The first tier charge could include the water resource management charge i.e. to cater for planning and implementing catchment management strategies, monitoring and assessment of water resources availability, quality and use, water quantity management, management of water use permits, water resources protection, quality management and water pollution control and water conservation and demand management.

- It is absolutely recommended to construct another water intake and treatment facility to supplement the current one which has less capacity to meet the current demand. The water company in conjunction with the AWSB should engage in sourcing funds to construct the intake works as soon as possible.
- The area lacks sewerage treatment system, which is absolutely important given increased population. This is because use of septic tank is associated with water pollution both surface and underground. Thus constructing the sewer system will save the scarce water resources from pollution and improve environmental status of the area.
- Rainwater harvesting techniques should be encouraged. The residents should be provided for with proper knowledge and techniques to harvest rainwater both for domestic and agricultural purposes to minimize dependence on surface and ground water. Equipments such as water storage tanks should be made affordable for the residents to encourage rainwater harvesting.

6.4 AREAS FOR FURTHER STUDIES

There are areas where it is felt that the study did not cover adequately due to its scope and limitations and as such it is recommended that further research be carried out on the following; first there is need to explore the social- cultural and economic impacts that effects and have impact on sustainable water supply and demand management; second, to identify the implications of over- utilizing the groundwater in the area; third, to determine the organizational and management structures and their impact on water supply services and fourthly, to find out the possibilities of rainwater harvesting to complete the existing water sources.

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APPENDICES

APPENDIX 1: HOUSEHOLD QUESTIONNAIRE

KENYATTA UNIVERSITY

DEPARTMENT OF ENVIRONMENTAL PLANNING & MANAGEMENT MASTER OF ENVIRONMENTAL PLANNING AND MANAGEMENT

QUESTIONNAIRE ON CHALLENGES AND OPPORTUNITIES FOR SUSTAINABLE WATER SUPPLY AND DEMAND MANAGEMENT IN RURIU MUNICIPALITY

Questionnaire No Interviewer..... Location
Date.....

Introduction

This questionnaire is to solicit information on Challenges and Opportunities for Sustainable Water Supply and Demand Management in Ruiru Municipality and it is purely for academic purposes. All the information gathered will be treated with utmost care and confidentiality. Your help is highly appreciated. Thank you.

1. Household Characteristics

Household member	Age	Sex	Level of Education	Occupation
1				
2				
3				
4				
5				
6				
7				
8				

2. Indicate the monthly household income bracket

3000 and below 3001-10,000 10,001-15000 15001-20,000 20,000 and above

Water supply

3. Please fill in the table below

Sources of water	Uses	Amount	Distance	Cost	Reliability	Quality
Direct municipal connection						
Communal municipal connection						
Water vendor						
Water kiosk Municipal						
Water kiosk borehole						
Borehole						
Wells						
Rainwater						

4. Are you affected by Water Rationing? Yes No

5. If yes to the question above, how often.....

6. How do you supplement water during shortage period?

Rainwater River water boreholes water kiosks others (specify)

Un-accounted For Water

7. How often do you receive your water bill?

Monthly weakly other (specify)

8. Do you think the water bill is accurate? Yes No

9. If no, give reasons.....

10. Has your water been disconnected for non-payment? Yes No

11. Do you know of any illegal water connections? Yes No

12. If yes, who is responsible?

Small enterprises households industries other (specify)

13. In your opinion, what are the causes of water loss in this area?

Pipe bursts leakages illegal connections others (specify)

14. How can you reduce the amount of water consumed by your household?
 Recycling conserving devices other (specify)
15. Are you aware of water reforms? Yes No
16. If yes, what do the reforms entail?
17. Has the cost of water gone up recently? Yes No
18. If yes, by how much?
19. What problems have you experienced in your home due to water shortage?
 Diseases high costs of buying water long hours fetching water other
(specify)
20. What are the factors that constrain efficient water supply and demand management in the region?
 Drought pollution lack of funds poor infrastructure low production
 others (specify)
21. What do you think are the opportunities for sustainable water supply in this area?
.....
22. What do you think should be done by the following stakeholders in order to improve Water Supply and Demand Management for Ruiru Municipality?
- a. Consumers.....
 - b. Ruiru Municipality.....
 - c. Ministry of Water and Irrigation.....
 - d. Ruiru Water and Sewerage Company.....
 - e. Relevant CBOs/NGOs.....
 - f. Any other (specify).....

**APPENDIX 2: INTERVIEW SCHEDULE FOR ORGANIZATIONS/
ORGANISATIONS**

**KENYATTA UNIVERSITY
DEPARTMENT OF ENVIRONMENTAL PLANNING & MANAGEMENT
MASTERS OF ENVIRONMENTAL PLANNING AND MANAGEMENT**

Dear Sir/Madam,

I am carrying out study on “Challenges and Opportunities for Sustainable Water Supply and Demand Management in Ruiru Municipality” and I would like to request that you kindly assist me by filling in this questionnaire enable me to make appropriate recommendations for sustainable water supply and demand management for the area.

DECLARATION: The information and data obtained will be confidential and solely for academic purposes.

Thank you.

1. What should the following table be filled in?

Name of the Institution	
Name of the Officer (optional)	
Designation	
Duration of stay in institution	

2. For how long have your organization been operating here?

.....

3. What is the mandate of your institution?

4. What do your specific objectives concerning water supply and demand management in the region?

.....

5. What measures have you undertaken in order to achieve your objectives?

.....

6. How far have you achieved your objectives?
.....
7. What challenges does your organization face in performing its mandate/roles in water sector?
8. What changes in water quality and quantity have you seen in the region?
 - a. Water quality.....
 - b. Water quantity.....
9. What factors would you attribute these changes to?
10. What are the major constraints affecting water supply and demand management in this area?
11. Suggest measures that can be used to address the constraints.....
12. What opportunities still exist for sustainable water supply in this region?
.....
13. What should the following stakeholder do to achieve sustainable water supply and demand management in this area?
 - a. Ministry of water and irrigation.....
 - b. Ruiru Municipal Council.....
 - c. Ruiru Water and Sewerage Company.....
 - d. Consumers.....
 - e. Private sector.....
 - f. Any other (specify)

APPENDIX 3: OBSERVATION RECORD GUIDE

The checklist given below guided the process of observation to provide lenience of the condition of water supply facilities.

Facility	Condition	Adequacy	Remarks
	<input type="checkbox"/> Good <input type="checkbox"/> fair <input type="checkbox"/> bad	<input type="checkbox"/> Good <input type="checkbox"/> fair <input type="checkbox"/> bad	
Intake works			
Treatment facility			
Distribution pipes			
Pumping equipments			