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**UNIVERSITY OF NAIROBI**

**WATER SERVICES PROVISION IN NYANDARUA COUNTY**

**By: NJOROGE ANTONY MWAURA**

**F16/1293/2010**

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**DEPARTMENT OF CIVIL AND CONSTRUCTION ENGINEERING**

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A project submitted as a partial fulfillment for the requirement for

the award of the degree of

**BACHELOR OF SCIENCE IN CIVIL ENGINEERING**

# ABSTARCT

Nyandarua County has two water companies and about 106 community based organizations. Though there has been considerable efforts by these companies and organizations to supply water in the county, large areas in the county remain un-served and hence no access to clean water supply. The companies and the organizations supply water both by pumping and flow of gravity. This largely depends on the terrain, the location of the project and the source of water for supply.

The major sources of water supplied by the providers include boreholes, rivers and natural springs.

Most of the residents in Nyandarua depend on rain water for domestic water and also watering their farms. Many times the rains have been unpredictable making the residents of this area at a loss again. The available sources of water in this region are far from the households making the women and children travel far distances in search of water. This utilizes a lot of time which could have been otherwise engaged in an economic activity for further development in the region.

The rainfall patterns in this region are unpredictable and hence cannot be relied upon for farming and use. Nyandarua County is highly agricultural and hence a reliable supply of safe water is worthwhile.

This project involved the study of water services provision in Nyandarua County. The study considered the existing water service providers and the projects facilitating the provision of water in the county, study the effectiveness of the management of water service providers in the county and the various challenges faced by the water services providers in their bid to supply water in the county.

It involved a review of the existing write up on water service provision, water service providers, regulation governing the operation of water service providers and their performance. The research methods employed during the study included field surveys, interviews and questionnaire administration. The data was analyzed in terms of water companies and community based organizations (CBOs) in the county, their mode of water supply technology whether by pumping or by flow of gravity, their source of supply water, their management structure and the challenges faced by the companies in their bid to supply clean water in the county.

According to the study, it was found that the service providers face various challenges in the bid to supply water in the county. Among them included non-revenue water, leadership wrangles in their management structures, inadequate funds to expand their service areas, lack of treatment works to treat raw water hence end up supplying untreated water, unsafe for domestic use.

The study recommends that awareness trainings need to be carried out in the communities on the need for the water projects, community based organizations to consider working under the management of the water companies to solve the challenge of management problems, installations of water meters at strategic positions to help deal with the issue of non-revenue water and also the service providers to raise the water tariffs to raise more funds and improve on the water supply systems.

Also, the study recommended the need for water treatment plants to treat the water making it fit for the domestic use and the adoption of the various water projects by the county government for funding and maintenance.

# DEDICATION

I dedicate this project to my parents Mr. and Mrs. Stephen Njoroge who have worked tirelessly, self-sacrificed to see the fulfillment of my academic progress. Not forgetting my siblings and close friends who have continually stood with me at all times, encouraging and strengthening me during the challenging times in my academic life.

I also dedicate this work to my home county Nyandarua. It has always been my dream that the county will rise above the social economic development challenges among them the challenge of inadequate water supply.

# ACKNOWLEGEMENTS

I would like to register my sincere gratitude to my supervisor Engineer. S.K Ngari for his generous support, positive criticism, genuine concern, fatherly advice and constant encouragement during the project study. It has been a success largely because of his support.

I would also like to thank Mr. B M Kimani, the managing director Nyandarua Water Company, Mrs. Mary Kamau the managing director Olkarou Water and Sanitation Company, Mr. James Wachira the Manager Nyakanja water project, Mrs. Ruth Njambi the secretary Munyeki water project all for the support and generous information and contribution to the success of the project.

I would finally thank the Almighty God for His strength and grace during my academic walk. He is indeed Ebenezer in My life.

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## List of acronyms

AWWA American Water Works Association

CBOs Community based organizations

DBT Decreasing-Block Tariffs,

DWO District Water Office

FBOs Faith-based organizations

IBT Increasing-Block Tariffs

IWES Institution of Water Engineers and Scientists

MDGs [Millennium Development Goals](http://en.wikipedia.org/wiki/Millennium_Development_Goals)

NYADAWAS Nyandarua Water and Sanitation Company

O + M Operation and Maintenance

OLWASCO Ol’kalou Water and Sanitation Company.

RVWSB Rift Valley Water Services board

SHG Self Help Groups

**List of acronyms continued;**

SPA Service Provision Agreements

UN [United Nations](http://en.wikipedia.org/wiki/United_Nations)

WASREB Water Services Regulatory Board

WRMA Water Resources Management Authority

WSBs Water Services Boards

WSPs Water Supply Service Providers

WSTF Water Services Trust Fund

WUAs Water User Associations

## 

# INTRODUCTION

‘An old saying goes, “water is life”. Clean available water is essential to man animals and plants. All this constitutes life. Without water, the existence of the above would be much threatened.

From the beginning of times, people have always settled close to water sources, along rivers, beside lakes, near water springs or near natural wells. It therefore goes without saying that water is such an important parameter that holds life in place.

Provision of safe, adequate and accessible supply of water coupled with good sanitation programs is important in ensuring good health care. This will consequently reduce many of the diseases affecting the underprivileged folks who either live in the slums or poor dry rural areas. Now, for a remarkable social, economic development of any community, an adequate supply of safe water nonnegotiable.

There are many factors that contribute to development. Among the key factors are time and energy saved during the search of clean and safe water for use.

Despite the dire need for a reliable clean water supply, the worrying fact is that; according to The [United Nations](http://en.wikipedia.org/wiki/United_Nations) (UN) estimates, of 1.4 billion cubic kilometers (1 quadrillion acre-feet) of water on [Earth](http://en.wikipedia.org/wiki/Earth), only 200,000 cubic kilometers (162.1 billion acre-feet) represent fresh water available for human consumption.(Wikipedia 2014)

More than one in every six people in the world is water stressed, meaning that they do not have access to potable water. Those that are water stressed make up 1.1 billion people in the world and are living in developing countries.

Water scarcity is the lack of sufficient available water resources to meet the demands of [water usage](http://en.wikipedia.org/wiki/Water_usage) within a region. It already affects every continent and around 2.8 billion people around the world at least one month out of every year. More than 1.2 billion people lack access to clean drinking water.

Water scarcity involves water stress, water shortage or deficits, and water crisis. While the concept of water stress is relatively new, it is the difficulty of obtaining sources of fresh water for use during a period of time and may result in further depletion and deterioration of available water resources. Water shortages may be caused by [climate change](http://en.wikipedia.org/wiki/Climate_change), such as altered weather patterns including [droughts](http://en.wikipedia.org/wiki/Droughts) or [floods](http://en.wikipedia.org/wiki/Floods), increased [pollution](http://en.wikipedia.org/wiki/Water_pollution), and increased human demand and over use of [water](http://en.wikipedia.org/wiki/Water).

Climate change has caused receding glaciers, reduced stream and river flow, and shrinking lakes and ponds. Many aquifers have been over-pumped and are not recharging quickly. Although the total fresh water supply is not used up, much has become polluted, salted, unsuitable or otherwise unavailable for drinking, industry and agriculture. (Wikipedia). A water crisis is a situation where the available [potable](http://en.wikipedia.org/wiki/Potable_water), unpolluted water within a region is less than that region's demand. Water scarcity is being driven by two converging phenomena: growing freshwater use and depletion of usable freshwater resources. (According to the [United Nations Development Programme](http://en.wikipedia.org/wiki/United_Nations_Development_Programme)) some of the causes of water crisis include; Inadequate access to safe [drinking water](http://en.wikipedia.org/wiki/Drinking_water), Inadequate access to water for sanitation and waste disposal for 2.5 billion people, [Groundwater](http://en.wikipedia.org/wiki/Groundwater), [over drafting](http://en.wikipedia.org/wiki/Overdrafting) (excessive use) leading to diminished [agricultural](http://en.wikipedia.org/wiki/Agriculture) yields, Overuse and [pollution](http://en.wikipedia.org/wiki/Pollution) of water resources harming [biodiversity](http://en.wikipedia.org/wiki/Biodiversity) and regional conflicts over scarce water resources sometimes resulting in [warfare](http://en.wikipedia.org/wiki/War).

Surprisingly, [waterborne diseases](http://en.wikipedia.org/wiki/Waterborne_diseases) and the absence of sanitary [domestic water](http://en.wikipedia.org/wiki/Domestic_water_system) are one of the leading causes of death worldwide. For children under age five, waterborne diseases are the leading cause of death. At any given time, half of the world's hospital beds are occupied by patients suffering from waterborne diseases. According to the ([World Bank](http://en.wikipedia.org/wiki/World_Bank)), 88 percent of all waterborne diseases are caused by unsafe drinking water, inadequate sanitation and poor hygiene. This is unfortunate and sad.

The reduction of water scarcity is a goal of many countries and governments. The [UN](http://en.wikipedia.org/wiki/United_Nations) recognizes the importance of reducing the number of people without sustainable access to clean water and sanitation. The [Millennium Development Goals](http://en.wikipedia.org/wiki/Millennium_Development_Goals) (MDGs) within the [United Nations Millennium Declaration](http://en.wikipedia.org/wiki/United_Nations_Millennium_Declaration) state that by 2015 they resolve to "halve the proportion of people who are unable to reach or to afford safe drinking water."

Among the major types of water scarcity in developing countries is the economic water scarcity. This is caused by a lack of investment in infrastructure or technology to draw water from rivers, aquifers or other water sources, or insufficient human capacity to satisfy the demand for water. One quarter of the world's population is affected by economic water scarcity. Symptoms of economic water scarcity include a lack of infrastructure, causing the people without reliable access to water to have to travel long distances in or fetch water, which is often contaminated from rivers for domestic and agricultural uses. Large parts of Africa suffer from economic water scarcity; developing water infrastructure in those areas could therefore help to reduce poverty. Critical conditions often arise for economically poor and politically weak communities living in already dry environment.

The Government of Kenya is upfront and is committed to reducing the proportion of people without sustainable access to safe drinking water by 2015 as clearly spelt in the United Nations MDGs. Indeed the water sector has undergone reforms aimed at improving management of water resources and sanitation service in the country quoting the development of the National policy on water resources Management, published as a sessional paper no. 1 followed by the enactment of the water act 2002. (faolex.fao.org/docs/pdf/ken37553-a.pd)

Although the challenges facing water supply a service provision and water sanitation services are interrelated, this study focuses on water supply service provision in Nyandarua County. This study is aimed at identifying the challenges facing the residents of Nyandarua people in their quest to attain a reliable safe water supply.

## Problem statement

The challenge of community development in many Kenyan communities in the rural areas has been hastened by inadequate supply of safe water. Though the problem of water supply in the rural areas have been neglected for long by the assumption that there is available water in the rural areas, the fact is that, only a small portion of the residents have access to clean water. Many people especially women and children are therefore forced to walk for long distances in the search of safe water. This exercise is not only tiresome but also cumbersome. This has caused people to use water from contaminated sources endangering human health.

Among these communities is Nyandarua County. It is clear that some parts of the county are well watered by natural rivers flowing from the Aberdare ranges while some parts remain dry various seasons of the year.

Water service providers have been facing various challenges hindering them from supplying adequate and efficient water to the residents of this county. This has led to the stalling of established water projects or failure to implement otherwise designed projects.

Most of the residents in Nyandarua depend on rain water for domestic water and also watering their farms. Many are times the rains have been unpredictable making the residents of this area at a loss again. The available sources of water in this region are far from the households making the women and children travel far distances in search of water. This utilizes a lot of time which could have been otherwise engaged in an economic activity for further development in the region.

The rainfall patterns in this region are unpredictable and hence cannot be relied upon for farming and use. Nyandarua County is highly agricultural and hence a reliable supply of safe water is worthwhile.

A reliable and efficient water service will ensure that the rich agricultural zone continues to feed the nation. It is therefore much necessary to study the water services supply situation, the efficiency of the water services providers and the challenges faced by the service providers in their bid to ensure adequate supply of water.

It is true that the available sources of water in the county; the rivers, dams, springs, wells and rainwater can serve the residents well upon proper provision, distribution and management. Now, domestic demand is influenced by various factors among them; economic, social and technological, religious, geographical and water habits. These factors should be inherently considered to precisely estimate the water demand for a given community.

The County receives abundant amount of rainfall resulting into fairly heavy surface run-off and flows in streams and rivers, but due to lack of storage facilities all this water is not harnessed for use when required. There is therefore need to identify suitable dam sites to tap and store this water to meet the rapidly increasing domestic, industrial and irrigation water demand.

Some of the boreholes that are in existence are not operational because of high operational costs as they are electrically powered.

Possibility of using solar powered pumps should be explored. Their revival will contribute towards increasing the water coverage in the county.

To further increase irrigated land in the county the dams and pans that have silted over time can be rehabilitated and water abstracted using appropriate low cost technology like solar power and the water used for drip irrigation.

Considering the county, when some of these challenges are understood, then amicable solutions can be proposed to the various service providers in the county to ensure efficient supply and flow of water to the residents.

## Objectives

The objectives of this project report were to;

1. Study the existing water service providers and the projects facilitating water service provision in Nyandarua County
2. Identify the challenges facing the water service providers in their bid to provide continuous water in the county
3. Evaluate the effectiveness of the management of water services providers in the county.

## Research methodology

The study involved a reconnaissance of the study area to survey the various existing water service providers as well as determining the appropriate methods of data collection. The study was carried out by administration of questionnaires to the relevant authorities.

The following questionnaires were administered.

1. Questionnaire to a water and sanitation company by the Olkarou Water and Sanitation Company
2. Questionnaire to a community based organization using Mpesa as mode of payment for water by Munyeki Water project
3. Questionnaire to a CBO with an SPA from the RVWSB by Nyakanja Water project
4. Questionnaire to a water project (CBO) managed by Nyandarua Water Company by Itonyero-Subuku-Simbara project.

In addition to questionnaires, observation of the existing water projects, the condition of the facilities used to convey water to the consumers was done. During the interaction with the managers of the companies and the projects, oral interviews were done to identify the various challenges that faced them in the bid to supply clean water to the communities.

## Project findings

The findings of this study are discussed in chapter four. These findings were obtained from the questionnaires that were administered to the various authorities, the companies and the community based organizations.

The findings were classified into two categories i.e.

1. Findings regarding the water companies

2. Findings regarding the community based organizations

The results were also extracted from existing water reports in the county obtained from the ministry of Water in Nyandarua County.

The data obtained was also classified to achieve the objectives of the project study in the following from.

1. Methods of water supply technology
2. Source of water for service provision
3. Challenges facing the service providers as they supply water to the residents
4. The management structure of the service providers

# CHAPTER TWO

# LITERATURE REVIEW

## Water service provision

This is the provision of [water](http://en.wikipedia.org/wiki/Water) by [public utilities](http://en.wikipedia.org/wiki/Public_utility), commercial organizations, community endeavors or by individuals, usually via a system of pumps and pipes.

Water supply has a long history. For people to access clean drinking water, water has to be supplied from its source to the consumer. A service is therefore required to provide this entity to the consumers without inconveniences.

### Water supply service providers (WSPs)

A **service provider** is an entity registered under the Water Supply Act to provide water or sewerage service. Requirement for a water service provider, their rights, and their benefits is well outlined in the Water Act. For example, in Kenya, the water service providers are governed by the water Act draft bill which was enacted in the year 2002 amended in 2014.

Under the act, the service providers have to be licensed by the relevant government authorities and county governments to ensure all rules are adhered to.

Several entities have to apply for the registration of a water supply service provider. These include;

1. A local government that owns infrastructure for supplying water
2. A water authority that owns infrastructure for supplying water
3. An entity who is the owner of one or more elements of infrastructure for supplying a water service for which a charge is intended to be made
4. An entity that is prescribed under a regulation as a related entity of the relevant infrastructure owner.

It is however important to note that owning infrastructure for the production and supply of recycled water doesn’t not guarantee any entity as a service provider but must also own other facilities for supplying water services.

### Roles of a water service providers

The water supply service providers will be charge with the following responsibilities;

1. They oversee water harvesting and collection. This includes among other things water storages, extraction of groundwater and replenishment of the same and also extraction of water in the rivers.
2. They are responsible for the transmission of water from its sources to the consumers
3. They are in charge the reticulation of water. The service providers shall oversee the drainage of water other than the storm water and
4. Will oversee the treatment of water and recycling of the same. This is to ensure that the water that is supplied to the consumer is free of disease causing organisms( water act 2002)

### Categories of water supply service providers

1. **Private sector participation**

About 10% of urban water supply is provided by private or mixed public –private companies. These entities will do so under an agreement, a lease or a management contract. Under these arrangements, the public entity entrusted with the supply of water legally shall delegate some certain aspects of provision of the service to the private provider for a specified period of time. They account for a small percentage to due to management and governance issues and hence most countries in the world have reverted to public water provision entities.

1. **Public water service provision**

The greater percentage, about 90% of water supply and sanitation services are in the public sectors. They are owned by the state, local authorities, collectives or even cooperatives.

They are nonprofit making organizations with an aim of providing common benefit to the ‘mwanachi. The challenge with this mode of service is inefficiency caused by mainly political interference which lead to at many times overstaffing and low labor productivity. In the end, the losers are the poor who will end up even paying more charge per liter of water than the rich. This is because the rich are well connected to water supply services utilities as opposed to the poor. “Modest improvement of public water operators will have immense impact on global provision of services,” say former Japanese Prime minister Ryuto Hashimoto.

1. **Community based organizations (CBOs)**

These are water service providers mostly in the rural areas where communities unite and join hands together, mobilize funds and set up water supply services. They do so by provision of water storage utilities like tanks for water harvesting and storage.

1. **Faith-based organizations (FBOs)**

They have been supporting safe drinking water and sanitation projects for many years, on several levels. These include prayer, advocacy and financial assistance; religious congregations have brought extraordinary support to this critical global health concern.

1. **Governance arrangements**

These define the relationships between the service provider, its owners, its customers and regulatory entities.

They determine the financial muscle of the service provider and thus its ability to maintain its assets, expand services, attract and retain qualified staff, and ultimately to provide high-quality services. Key aspects of governance arrangements are the extent to which the entity in charge of providing services is insulated from emerging political intervention; and whether there is a sole mandate and political will to allow the service provider to recover all or at least most of its costs through tariffs and retain these revenues. If water supply is the responsibility of a department that is integrated in the administration of a city, town or municipality, there is a risk that tariff revenues are diverted for other purposes. In some cases, there is also a risk that staff are appointed mainly on political grounds rather than based on their professional credentials.

### Classification of WSPs

Ensuring fair comparison between the performance of various WSPs, companies have been classified on the basis of size, operating environment and ownership structure.

**Categorization by size**

Depends on the number of connections for both water and sewer

Classified into very large, large, medium and small WSPs. This is relevant because it has a direct correlation to commercial viability, financial sustainability and human resource capacity

**Categorization by type of service area**

This takes into account differences in geographical spread, capacity levels, and income levels of consumers and availability of capital for investments. This considers where most of the revenue of the revenue of the WSPs comes from.

**Classification by ownership structure**

WSPs can either be publicly owned or privately owned. This takes into account differences in the customer base. Publicly owned WSPs serve a wide range of customers of high and low income within the area of service whereas the privately owned WSPs serve medium to high income customer base.

Water services providers are therefore classified into;

* Category I; this is for medium to large WSPs operative mostly in **urban areas** – WSPs in this category are limited liability companies owned by one or more local authorities. They provide both water and sewerage services.
* Category II; this is for community projects in **rural areas** – these are community water supplies which are managed by WSPs registered as Water User Associations (WUAs) by the Registrar of Societies.
* Category III for **private sector providers** – for example, there is one SPA in this category (Runda Estate).
* Category IV for bulk water supply – this is the responsibility of the National Water Conservation and Pipeline Corporation

The population of low income settlements such as depends on water provided by informal small service providers.

Informal **small service providers** (SSPs) provide water in both rural and urban low income settlements. Some of them sell water from tanker trucks or through jerry cans, often at prices that are five to ten times that of piped water supply. Others are self-help groups, often run by women, who provide piped water supply. (Wiki loves Africa 2014)

### Performance of WSPs

The performance of WSPs is analyzed with respect to the following key performance indicators.

1. Water coverage

This refers to the number of people served with cleaning water by a WSPs expressed as a percentage of the total population within the service area of the WSPs. It assesses the performance of the in executing the mandate of the utility of supplying portable water to consumers.

1. Sanitation coverage

This refers to the number of people with access to improved sanitation facilities, expressed as a percentage of the total population within the service area of the WSPs.

It measures the performance with regard to the provision of sewerage and onsite sanitation services. Improved facilities include flush or pour flush to piped sewer systems, septic tanks, and ventilated improved pit latrines.

1. Non-revenue water(NRW)

It refers to the difference between the amount of water produced from distribution and the amount of water billed to customers. It measures the efficiency of the WSPs in delivering the water it produces to the customer take off point.

It captures both technical losses (leakages) and commercial losses (illegal connections/water theft, metering errors and unbilled authorized consumption)

Acceptable benchmark of 20-25% is required.

1. Drinking water quality(residual chlorine and bacteriological quality)

It measures the portability of the water supplied by WSPs. It is a critical performance indicator since it has direct impact on the health of consumers

1. Hours of supply

This refers to the average number of hours per day, that a utility provides water to its consumers. It measures the continuity of services of WSPs and thus the availability of water to its customers. It shows the extent to which the WSPs is making progress towards the fulfillment of the human right to water and sanitation in terms of availability of water in sufficient quantities.

1. Metering ratio

This is the number of connections with operational meters as a percentage of the total number of active water connections. It measures to what extent the WSPs has implemented metering as a management tool. Metering not only provides critical information to WSPs in managing NRW but also allows them to charge consumers according to their consumption and thereby manage demand.

1. Revenue collection efficiency

Refers to the total amount collected by WSPs expressed as a percentage of the total billed in a given period. It measures the effectiveness of the revenue management of the WSPs. It is an indicator on the commitment of management in optimizing the WSPs revenue inflow and is indirectly a reflection of customers’ willingness to pay and their satisfaction with services provided.

1. Operation and maintenance (O + M)

It is the extent to which internally generated funds cover the cost of running WSPs. O + M cost coverage is critical to the performance of WSPs as it is the first step towards full cost coverage. It ensures long term financial sustainability. It is estimated to have full cost coverage when it reaches at least 150% O + M cost coverage.

1. Staff productivity

It refers to the number of staff in employment for every1000connections. It measures the efficiency of WSPs in utilizing its staff, thus a low figure is desirable

## Water abstraction

This is the process of taking [water](http://en.wikipedia.org/wiki/Water) from any source, either temporarily or permanently. This water can be used for [irrigation](http://en.wikipedia.org/wiki/Irrigation), industry, recreation, flood control or treatment to produce [drinking water](http://en.wikipedia.org/wiki/Drinking_water).

Water service providers extract from the various sources and either treats it supplying to the consumers.

Most water supplied in Nyandarua County is abstracted from the natural flowing rivers and then channeled via gravity to the consumers.

A water abstraction license is needed when a utility plans to extract water from a source.

### Water abstraction license

This is a permit that allows a water utility to extract water from its source. There are however abstractions that do not require licenses. For example according to the water act section 26, a permit is not required from the following activities;

* Abstraction or use of water without the employment of works from or any water resource for domestic purposes by any person having lawful access to the source.
* Abstraction of water from a spring which is situated wholly within the boundaries of the land of the owner
* For the storage of water in or the abstraction of water from a reservoir constructed for the purpose of such storage and which does not constitute a water course for the purpose of the act.
* some land drainage operations (for example, flood protection)

1. water used for fire fighting
2. abstractions in relation to dewatering quarries, mines and other building or engineering operations
3. trickle irrigation

### Impoundment

An impoundment is a structure within inland waters that can permanently or temporarily change the water level or flow. This includes: dams weirs, fish passes, hydropower turbines, sluices penstocks, culverts, lock gates, retaining walls, flumes, reservoir embankments and temporary diversions during construction work. An impoundment license is required before the structure is put in place. However some e impoundments do not require a license.

## Water pricing

This is a term that covers various processes to assign a price to water. These processes differ under different circumstances

Various types of water needs are assigned different prices depending on the need.

The various types of water sold including;

* 1. Bottled water

Prices for [bottled water](http://en.wikipedia.org/wiki/Bottled_water) are set in the market. Retail prices vary widely between countries, brands, bottle sizes (0.3 liter to 20 liters) and place of sale (supermarket, restaurant etc.)

* 1. Tanker trucks

Prices for water sold by tanker trucks in bulk, which is common in cities of some developing countries for households without access to piped water supply, are set in the market.

* 1. Utility tariffs

These are prices for piped water supply provided by utilities, be they publicly or privately managed, are determined by administration. Water services providers in Kenya assign a tariff set by the water regulatory bodies to the consumers. (See in section on water tariff)

* 1. Irrigation

Prices for irrigation water that is being provided by a public agency are also typically determined administratively.

A flat rate is commonly used, since metering is not common in agriculture Kenya. Pricing systems in Kenya for irrigation include;

1. Area-based tariffs, sometimes differentiated by type of crop grown
2. Volumetric pricing, which requires measurement

Tariffs can be paid in the form of labor, which holds mainly in communal types of management in traditional irrigation systems, or in cash. Tariffs can also vary between seasons, with higher tariffs charged during the dry season.

* 1. Direct abstraction

Most countries there do not charge for abstracting water directly from rivers, lakes and aquifers. However, some countries do levy volumetric charges or fees for water abstraction rights. These charges are typically levied on industries, utilities and farmers. Fees for water abstraction and discharge exist. Water agencies charge the revenues which are re-invested in the water sector.

### Water tariffs

This is a price assigned to water supplied by a [utility](http://en.wikipedia.org/wiki/Public_utility) through a piped network to its customers. The term is also often applied to wastewater tariffs. Water and wastewater tariffs are not charged for water itself, but to recover the costs of [water treatment](http://en.wikipedia.org/wiki/Water_treatment), water storage, transporting it to customers, collecting and [treating wastewater](http://en.wikipedia.org/wiki/Wastewater_treatment), as well as billing and collection.

Prices paid for water itself are different from water tariffs. They exist in a few countries and are called water abstraction charges or fees

Water tariffs vary widely in their structure and level between countries, cities and sometimes between user categories (residential, commercial, industrial or public buildings). The mechanisms to adjust tariffs also vary widely. (OECD 1987)

In many developing countries tariffs are set below the level of cost recovery, even without considering a rate of return on capital. This often leads to a lack of maintenance and requires significant subsidies for both investment and operation.

#### Tariff setting

They are set based on a number of formal criteria defined by law, as well as informal criteria Formal criteria typically include:

* financial criteria; this aims at cost recovery
* economic criteria it targets the efficiency pricing based on [marginal cost](http://en.wikipedia.org/wiki/Marginal_cost)
* Environmental criteria this includes the incentives for [water conservation](http://en.wikipedia.org/wiki/Water_conservation)

#### Types of tariff structures

Tariff structures include;

1. A volumetric tariff; this is a situation where [water metering](http://en.wikipedia.org/wiki/Water_metering) is applied
2. A flat rate, in this particular case, no [water metering](http://en.wikipedia.org/wiki/Water_metering) is applied.

Volumetric tariffs can be proportional to consumption known as linear tariffs, increase with consumption (increasing-block tariffs, IBT), or decrease with consumption (decreasing-block tariffs, DBT).

Linear volumetric tariffs are the most common form of water tariffs

* Tariff levels

Many utilities charge higher tariffs for commercial and industrial customers than for residential users, in an effort to cross-subsidy residential customers.

* Tariff adjustment processes

This is the process of adjusting water tariffs which differs greatly from one location to another. In many large countries the process of price adjustment takes place at the municipal level. Rules for price adjustments vary greatly.

In the case of public service provision, tariffs are typically adjusted through a decision by the municipal council after a request by the municipal utility. Some countries, stipulate by law that all the financial costs of service provision must be recovered through tariff revenues. Others countries define cost recovery as a long-term objective.

In the case of private service providers tariff adjustment rules are often laid out in concession or lease contracts, often providing for [indexation](http://en.wikipedia.org/wiki/Indexation) to [inflation](http://en.wikipedia.org/wiki/Inflation).

In some developing countries, water tariffs are set at the national level. Tariff increases are often considered a politically sensitive issue and have to be decided by the Cabinet of Ministers or a National Pricing Commission. In Kenya for example, water tariffs are set by regulatory bodies set at national level by the ministry of water and irrigation.

* Affordability and social protection measures

Affordability of water charges for low-income households is a significant issue. In developing countries, the poor are often not connected to the network and often pay a higher share of their small incomes for petty quantities of water supplied by water vendors through trucks, carts from water kiosks.

On the other hand, utility bills paid by those fortunate enough to be connected to the network are very low in some developing countries. Different countries have introduced a variety of approaches to protect the poor from high water tariffs. (**Wikipedia 2015**)

### Water metering

This is the process of measuring water use.

Water meters are used to measure the volume of water used by residential and commercial building that is supplied with water by a public water supply system.

They can also be used at the water source, well, or throughout a water system to determine flow through a particular portion of the system. Mostly water meters measure flow in cubic metres (m3) or litres though some like the USA and some other countries water meters are calibrated in [cubic feet](http://en.wikipedia.org/wiki/Cubic_foot) (ft.3)

#### Types of metering devices

The two common approaches to flow measurement are [displacement](file:///C:\Users\Makubo\Downloads\wate%20net\Water%20metering.htm#Displacement_water_meters) and [velocity](file:///C:\Users\Makubo\Downloads\wate%20net\Water%20metering.htm#Velocity_water_meters). They each make use of a variety of technologies.

Common displacement designs include oscillating piston and nutating disc meters.

Velocity-based designs include single- and multi-jet meters and turbine meters.

There here are electromechanical meters, like prepaid water meters and automatic meter reading meters.

Water meters are generally owned, read and maintained by a public water provider such as a city, rural water association or private water company. In some cases an owner of a home park, apartment complex or commercial building may be billed by a utility based on the reading of one meter, with the costs shared among the tenants based on size of flat, number of inhabitants or by separately tracking the water consumption of each unit. This is known as [sub metering](http://en.wikipedia.org/wiki/Utility_submeter).

* 1. Displacement water meters

This type of water meter is most often used in residential and small commercial applications. It relies on the water to physically displace the moving measuring element in direct proportion to the amount of water that passes through the meter. The piston or disk moves a magnet that drives the register.

* 1. Velocity water meters

Velocity-type meter measures the velocity of flow through a meter of a known internal capacity. The speed of the flow can then be converted into volume of flow to determine the usage. They have an adjustment vane for calibrating the meter to the required accuracy.

* 1. Prepaid water meters

With prepaid water meters the user purchases and prepays for a given amount of water from a vending station. The amount of water credited is entered on media such as an IC or RF type card or sim card. The main difference is whether the card needs a contact with the processing part of the prepaid water meter. In some areas a prepaid water meter uses a keypad as the interface for inputting the water credit.

#### Water meter reading

Different size meters indicate different resolutions of the reading. One rotation of the sweep hand may be equivalent to a set amount of water say 1m3- 10 m3.

It is common for residential and commercial drinking [water supply](http://en.wikipedia.org/wiki/Water_supply) in many countries, as well as for industrial self-supply with water. It is less common in [irrigated agriculture](http://en.wikipedia.org/wiki/Irrigated_agriculture), which is the major water user worldwide.

1. Benefits of metering

Water metering helps in the following.

1. It provides an incentive for water conservation, in conjunction with volumetric pricing.
2. it helps to detect water leaks in the distribution network, thus providing a basis for reducing the amount of [non-revenue water](http://en.wikipedia.org/wiki/Non-revenue_water);
3. It is a precondition for quantity-targeting of water subsidies to the poor.
4. Problems associated with the use of meters

The problems arise particularly in the case of intermittent supply, which is common in many developing countries. Sudden changes in pressure can damage meters to the extent that many meters in cities in developing countries are not functional.

Some types of meters become less accurate as they age, and under-registering consumption leads to lower revenues if defective meters are not regularly replaced.

Many types of meters also register air flows, which can lead to over-registration of consumption, especially in systems with intermittent supply, when water supply is re-established and the incoming water pushes air through the meters.

1. Costs incurred by metering

The costs of metering include:

1. The investment costs to purchase and install meters,
2. The recurrent costs to read meters and to issue bills based on consumption instead of bills based on monthly flat fees**.(Wikipedia 2015)**

## Water distribution

This is the conveyance of water from its source or the treatment reservoir to the consumer. The purpose of municipal water delivery systems is to transport potable water from a water treatment facility to residential consumers, for use as drinking water, water for cooking, water for sanitary conditions, and other water use in a domestic environment. Water supply also is essential for business and industry to operate in a municipal environment. (Water supply systems and evaluation methods-2008)

According to Harry hickey, a water system has two primary requirements: First, it needs to deliver adequateamounts of water to meet consumer consumption requirements plus needed fire flow requirements. Second, the water system needs to be reliable; the required amount of water needs to be available 24 hours a day, 365 days a year.

Water distribution systems convey water drawn from the water source or treatment facility, to the point where it is delivered to the users. **(Water distribution systems 1984)**

A good example of a water supply system is the Washington, DC, supply system. It has a very old water system that has been updated in many ways. It serves as an excellent example of a basic municipal water supply system. Every municipal water system as a service provider has to have a water supply source that is both adequate and reliable for the city to be served.

### Continuous water supply

A municipal water supply system cannot service its customers unless there is a continuous supply of water to meet domestic consumption needs in the broadest sense and water needs for structural fire protection. Water sources need to be selected carefully to make sure that this fundamental requirement is met.

Taking a case study of Washington D.C, (water supply systems and evaluation methods-Harry Hickey) to main factors affect the supply of water. These are:

1) Quality of water: Water must be treated or purified to meet Regulatory Requirements established by the EPA (United States Government). The requirements are divided into 2 categories namely;

a) Residential communities with populations not exceeding 3,000; and

b) Combined residential and commercial communities that serve a population demand over 3,000.

2) Quantity of water: The quantity of water must be adequate to meet consumer consumption and fire-flow demands at any time of the day, day of week, and week of the year.

Maintaining a continuous or uninterrupted supply of water for municipal demands is a major challenge to many municipalities because of the following conditions: droughts, growing demands that cannot be met by the treatment plant, lack of adequate storage capacity, other communities drawing water from the same supply sources such as a lake or a river and undetected underground leakage on the pipe distribution system.

A municipality as a water service provider must recognize that the quantity of available water needs to be such that maximum daily consumption demands are satisfied at all times, even during periods of drought or after years of community growth.

Water consumption is highest during the hours that water is used for personal hygiene and cleaning, and when food preparation and clothes washing are done. Water use is lowest during the night.

This variation in flow can be dealt with by operating pumps in parallel and building balancing storage in the system. For small community water supplies the distribution system with water storage (e.g. a service reservoir) is the preferable option, given that supplies of electricity or diesel to power pumps will usually be unreliable. Although it can be kept simple, construction of such a system may represent a substantial capital investment and the design must be done properly. The distribution system of a small community water supply is designed to cater for the domestic and other household water requirements. Stock watering and garden plot irrigation water may also be provided. Service reservoirs accumulate and store water during the night so that it can be supplied during the daytime hours of high Water demand. **(Water distribution systems 1984)**

### Water distribution systems

A distribution system is a network of pipelines that distribute water to the consumers. They are designed to adequately satisfy the water requirement for a combination of domestic, Commercial, Industrial and Firefighting purposes. **(**[**http://www.ecs.umass.edu/cee/reckhow/courses/371/371hw03/371hw03s.pdf**](http://www.ecs.umass.edu/cee/reckhow/courses/371/371hw03/371hw03s.pdf)**)**

#### Features of a good distribution system

It should have adequate water pressure at the consumer's taps for a specific rate of flow (i.e., pressures should be great enough to adequately meet consumer needs. Pressures should not be excessive because development of the pressure head brings cost consideration and as pressure increases leakages increases too. Also purity of distributed water should be maintained. This requires distribution system to be completely water-tight. In addition, maintenance of the distribution system should be easy and economical and water should remain available during breakdown periods of pipeline. System of distribution should not such that if one pipe bursts, it puts a large area without water. If a particular pipe length is under repair and has been shut down, the water to the population living in the down-stream side of this pipeline should be available from other pipeline and during repairs, it should not cause any obstruction to traffic I. e the pipelines should not be laid under highways, carriage ways but below foot paths.

#### Types of water distribution systems

There are two main layouts of a distribution network. These are;

* Branched configuration
* Looped (or ”grid”) configuration

#### Branching system

It is Similar to the branching of a tree. It consists of

1. Main (trunk) line
2. Sub-mains
3. Branches

Main line is the main source of water supply. There is no water distribution to consumers from trunk line the Sub-mains are connected to the main line and they are along the main road. The branches are connected to the sub-mains and they are along the streets. The service connections are then given to the consumers from branches. This method has the following advantages;

1. It is a very simple method of water distribution.
2. Calculations are easy and simple to do.
3. The required dimensions of the pipes are economical.
4. This method requires comparatively less number of cut-off valves.

However, the method has the following disadvantages and hence not usually favored in modern water works practice.

1. The area receiving water from a pipe under repair is without water until the work is completed.
2. In this system, there are large numbers of dead ends where water does not circulate but remains static.
3. Sediments accumulate due to stagnation of the dead end and bacterial growth may occur at these points. To overcome this problem drain valves are provided at dead ends and stagnant water is drained out by periodically opening these valves but a large amount of water is wasted.
4. It is difficult to maintain chlorine residual at the dead ends of the pipe.
5. Water available for fire-fighting will be limited since it is being supplied by only one water main.
6. The pressure at the end of the line may become undesirably low as additional areas are connected to the water supply system.

#### The grid system

In this system, all the pipes are interconnected with no dead-ends. In such a system, water can reach any point from more than one direction.

The method has the following advantages.

* Since water in the supply system is free to flow in more than one direction, stagnation does not occur as readily as in the branching pattern.
* In case of repair or break down in a pipe, the area connected to that pipe will continue to receive water, as water will flow to that area from the other side.
* Water reaches all points with minimum head loss.
* At the time of fires, by manipulating the cut-off valves, plenty of water supply may be diverted and concentrated for fire-fighting.

However the method has the following disadvantages.

* Cost of pipe laying is more because relatively more length of pipes is required.
* More numbers of valves is required.
* The calculation of pipe sizes is more complicated.

It is therefore necessary that the service provider identifies the most appropriate method of water distribution to the consumers depending on the size of location, the demand of water and the ease of maintenance.

1. Water distribution by trucks

These are huge capacity trucks which are used to deliver water from a source or a storage reservoir, a well, river to the consumers. Trucks can also be used to ensure a continuous supply of water to the consumers where the pipeline has stopped. It is mainly done on small scale to supply water in small towns, communities and villages.

Also, the method is used to supply water to institutions such as schools, hospitals, colleges and organizations.

#### Distribution System Storage

One of the most important aspects of achieving optimal performance, reliability, and cost effectiveness in water system design is the placement of water storage within the framework of a community water system.

The two common methods of storing water on a water distribution system include;

* ground level storage;
* elevated storage

#### Functions of water system distribution system storage:

Storage capacity within the framework of a distribution system enables the system to process water at a time when a treatment facility would be unable to meet the systems demands or when the treatment facility is idle. Stored water provides the possibility to distribute the treated or finished water to one or more locations in the service areas that provides the best flow and pressure to the end user. **(Water Supply Systems and Evaluation Methods 2008)**

The principle advantages of water distribution storage include the fact that storage equalized demands on supply sources, water treatment facilities, plus the transmission and distribution mans. As a result, the sizes or capacities of these elements need not be as large as would be required if storage was not provided. Additionally, system flows and pressure can be improved and balanced or stabilized to better serve both consumer and required fire flows throughout the service area. Finally, reserve supplies are provided in the distribution system for other emergencies such as power outages and breaks in the water distribution system.

## THE WATER SECTOR ARRANGEMENT IN KENYA

### The water act

The act sets out the key elements of Kenya’s legislation on the water sector. It has been in application since October 17, 2002 when it received the presidential assent.

Being an act of parliament, its introduction vision is, “to provide for the management of conservation, use and control of water resources and for the regulation and management of water supply and sewerage services; 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 related purposes.

The act seeks to address all the challenges that resulted in wastage, manipulation and abuse of water sources and services. It creates the water resources management authority (WRMA) to oversee the use of water resources which are vested in the state.

According to the act, WRMA is a body corporate which is charged with the following duties;

* Developing principles, guidelines and procedures for the allocation of water resources
* Monitoring from time to time, reassessing the national water resources management strategy
* Receiving and determining applications for permits for water use
* Regulating and protecting water resources qualify from adverse impacts
* Managing and protecting water catchments
* Determining charges to be imposed for the use of water from any water resource in accordance with guide lines in the national resources management strategy.
* To gather and maintain information on water resources and from time publish forecasts, projections and information on water resources.
* To liase with other bodies for better regulation and management of water resources.
* To advice the minister concerning any matter in connection with water resources.

#### Water Services Trust Fund (WSTF)

The water act also establishes a water services trust fund which manages the resources of the fund, mobilizes additional resources for the Fund; formulate and implement principles, rules and procedures for financing projects, including efficiency and effectiveness of funds; Implementing measures to ensure efficient and equitable sharing of the resources of the Fund giving priority in resource allocation to:

* Areas in rural and urban which access to basic water services is below the national average;
* In rural areas which are vulnerable to the degradation or depletion of water resources;

And also provide support to local communities in the identification of projects and formulation of project proposals;

It also provides support to local communities to build capacity in project implementation and management paying out of the Fund such grants as the trustees may authorize from time to time. Importantly, the board also monitors the implementation of projects, maintaining and making publicly available information on the projects financed and project impact; and elaborating national implementation concepts which ensure efficient use of water and sustainability of developed infrastructure

#### Funds collected by licensed water service providers

The following shall be the rights of the licensed water service providers;

* All funds collected for water services by the licensed water service providers holding county or national public assets on behalf of the public through water services bills and other sources shall be used entirely for the purpose of covering costs for the provision of water services and asset development according to rules by the Water Services Regulatory Commission.
* The licensed water service providers shall not be required to pay any fees for the use of public assets for the provision of water services other than the repayments of loans acquired for the development of those assets
* No dividend or other payment shall be paid to the owners of public water service providers as long as universal access and the right to water services have not been achieved in the designated service areas.

### Water Services Regulatory Commission

The water act establishes a water services regulatory commission whose functions includes determining and prescribing national standards for the provision of water services and asset development for water service providers, validating the water and sewerage tariffs proposed by the county water service providers and approve their imposition in line with consumer protection, issuing licenses for the provision of water services, monitoring and regulating licensees and enforce license conditions.

The commission also develops a model Memorandum and Article of Associations to be used by all water companies applying to be licensed by the Water Services Regulatory Commissions to operate as water service providers. It also monitors compliance with standards including for the design, construction, operation and maintenance of facilities for the provision of water services, proposes to the Cabinet Secretary the nature, extent and conditions of financial support to be accorded to water service providers for providing water services, Monitoring progress in the implementation of the national water services strategy and make appropriate recommendations.

The board also maintains a national data base and information system on water services, establishes a mechanism for handling complaints from consumers regarding the quality or nature of water services and develops guidelines on the establishment of consumer groups and facilitate their establishment. It Carry out inspections at water service providers reporting annually to the public on issues of water supply and sewerage services and performance of relevant sector institutions. It also issues rules on water services and asset development which shall include business, investment and financing plans; in order to ensure efficient and effective water services and progressive realization of right to water services and finally advising the Cabinet Secretary on any matter in connection with water services.

### Water services boards (WSBs)

They areresponsible for the efficient and economical provision of water services in accordance with Water Act 2002.

The core functions of the board include;

* Planning for improvement in provision of Water supply and sanitation services.
* Appointing and contracting Water Services Providers.
* Asset holder of central government facilities

Nyandarua County is one of the counties under the service area of the Rift Valley Water Services board (RVWSB)

#### Rift Valley Water Services Board (RVWSB)

The Water Services Regulatory Board (WASREB) issued a 10 year license to RVWSB on 25th September 2009 to provide water services covering the 7 counties or their parts within its area of jurisdiction. Obligations of the Board are clearly set out in the License. However, in accordance with Section 55(1) of Water Act 2002, the Board can only provide these services through agents i.e. Water Service Providers (WSPs). So far there are 10 WSPs registered as water companies (Category I) and 24 registered as Water Societies (Category II) with whom the Board has signed Service Provision Agreement. There are also 569 Small Scale Community based water Service Providers registered with the Board.

#### Service Provision Agreements (SPA) by RVWSB.

One of the key functions of the RVWSB is appointing and contracting water service providers (WSPs) to provide water and sanitation services within their area of jurisdiction as agents of the Board in accordance with Section 55(1) of Water Act 2002. The WSPs are appointed by RVWSB through Service Provision Agreements (SPAs) between them and the Board.

### Challenges faced by RVWSB in bid to supply water.

Since the establishment of the Board the following key challenges/issues have been experienced in the provision of Water and Sanitation services:

1. Water Scarcity

Kenya is categorized as a water scarce country by global standards. The per capita fresh water availability in Kenya is 690 M3 per capita compared to the global standard of 1000M3 per capita. The situation in the Board area has been aggravated by degradation of water catchments leading to reduced ground water recharge. In addition Larger part of the Board area consist of mainly arid and semi-arid regions where developing water services will pose physical and other challenges relating to cost and type of technology to use. The challenge becomes more complicated when nomadic communities are involved and the effects of environmental degradation are compounded.

1. Very low or non-existent sewerage services

Only Nakuru, Naivasha and Molo Towns have sewerage plants but with very low connectivity. In anticipation of the increased population in the County Headquarters, there is urgent need to prepare and implement sewerage systems. Nyandarua County has no established sewerage system.

1. Poor Water Quality

Due to our location in the Great Rift Valley, ground water has high concentration of fluorides and other minerals beyond acceptable standards.

1. Inadequate investment in water infrastructure

To achieve the Millennium development Goals the Board requires an average investment of Kshs 2 billion annually. However the actual investments realized over the years has been way below this.

1. Transitional challenges emanating from the following

Article 43 1 D of the Constitution of Kenya 2010 states that “Every person has a right to clean and safe water in adequate quantities”. This therefore requires the roles of the various stakeholders to be redefined under the new constitution so as to achieve this target.

Despite the above challenges the board has made remarkable steps to ensure efficient provision of water to the residents of the county through the licensing of the various WSPS in the region.

# CHAPTER THREE

# RESEARCH METHODOLOGY

## Reconnaissance

A reconnaissance study carried out in some parts of the county to have a view of the water situation in the area, identifying the need for water in the county. Among the areas were Kinangop district and parts of Nyandarua south district.

Thereafter the time schedule was prepared with all necessary resources and contact persons identified who were in turn to help the data collection.

### Sampling

This refers to a situation where the learner takes a section of the population of the problem to represent the whole population. In this study, random sampling was done where a few selected water service providers were chosen for study.

## Data collection

In this study, two methods of data types were employed namely

1. Primary data; this is information collected from the field using primary methods of data collection methods.
2. Secondary methods; this is data that was obtained from existing literature.

### Primary data collection methods

1. Observation methods.

These methods involve direct filed observation of the various locations of the water situations in the county in the areas visited.

These included;

1. Existing water services facilities
2. Locations, condition of the water sources supplied to the customers.
3. Methods of water conveyance from the source to the consumers
4. Mode of water delivery to identify if by gravity or by pumping.

### Questionnaire method

This is a document carrying questions systematically to obtain data. For the case of study, one questionnaire was prepared and administered to the relevant authorities. Four questionnaires were filled representing the various categories of water service providers in the county with different technologies of water delivery.

1. Conducted an interview with Olkarou Water and sanitation company(OLWASCO)to represent water service providers in urban towns of Nyandarua
2. An interview with Nyandarua Water and sanitation company (NYADAWAS) to represent Water Company providing water services to rural areas.
3. A questionnaire by Munyeki water project to represent the community based organizations and also the technology of pumping water using solar panels.
4. A questionnaire to NYAKANJA water project to represent community based organization whose source of water is a natural spring and technology of water supply is pumping.

The parties and the authorities involved in the answering of the questionnaires were well briefed on the nature of the project, the purpose of the project and the impact it can have on the county upon well implementation.

The samples of the questionnaires used area attached in appendices.

### Photographing

This method involved taking photographs in the field. The photos captured included the existing water tanks, the sources of the water and the natural landscape of the specific areas of the county.

The photos are attached in the appendices.

### Interviewing

Interviews were also administered where questions were administered orally to the authorities.

Among them were the managing director, OLWASCO, Ministry of water Nyandarua County and the residents.

### Secondary data collection

This method was used to evaluate the problem under the study using the already existing literature.

Most of the data was obtained from the internet and relevant books as attached as references.

## Challenges during data collection

1. Extensive study area which made it hard to tour all the projects and get firsthand information.
2. Suspicions from the relevant authorities irrespective of careful explanation of the need for the information
3. Restrictions in terms of time and resources to permit a tour to more water projects and gather data as required.
4. Inadequate information from the respondents.

# CHAPTER FOUR

# CASE STUDY OF WATER SERVICES PROVISION IN NYANDARUA COUNTY

## DESCRIPTION OF STUDY AREA

### Location

Nyandarua County is an agriculturally-rich zone located on the north-western part of the former Central Province, west of the Aberdare Mountain Ranges bordering five counties namely; Lakipia to the north and north east, Muran'ga and Nyeri to the east, Nakuru to the west and south west, and Kiambu to the south. It has has seven Districts, namely; Nyandarua South, Nyandarua North, Nyandarua Central, Kipipiri, Kinangop, Mirangine and Nyandarua West districts. The county has an area of 3246 km2 lying between latitude 0°8‘ to the North and 0°50‘ to South and between 35° 13‘ East and 36°42‘ West about 100km from Nairobi.

### Physical features and scenery

The main physical features of the county include Kinangop Plateau and Ol’kalou/Ol’joroOrok plateau which have slopes that are interrupted by low undulating hills. The gentle slopes flatten to plain-like features encouraging formation of marshlands and swamps.

The county was affected by volcanic and faulting which gave rise to major land forms, the Great Rift Valley to the west and Aberdare ranges to the east.

The highest point of the Aberdare ranges is 3999m above sea level. There are steep slopes that have undergone great transformation through weathering creating shallow valleys and gorges. The ranges drop gradually in a series of faults giving way to an escarpment that has been broken into sharp valleys occasioned by change in levels of the river courses.

Many rivers flowing in the county have their sources in the Aberdare ranges.

### Climatic conditions

The county experiences moderate to low temperatures. The highest temperatures are recorded in the month of December, with a mean average of 250C while the lowest is recorded in the month of July, with recorded low temperatures of 2 0C.

The County receives a biomodal pattern of rainfall in the months of April to May and from October to November which averages between 700mm to 1500mm per annum

### Vegetation

Some areas in the county are in the highland savannah zone, characterized by scattered trees with expansive grass cover. In elevated areas, tree cover increases forming thick forests with thick undergrowth. However, most of the natural vegetation has been cleared leading to environmental hazards such as environmental degradation which has claimed large portions of arable land. This has had some negative effects such as reduced rainfall, global warming, soil erosion, climate change, poor health and reduced food production.

### Population

Population in the county stood at 596,268 as at the last national population census of 2009. This comprised 292,155 males and 304,113 females with a population growth rate of 3.3%. The population density is about 184 people per Km2. Nyandarua county has approximately 143,879 households.

### Economic activities

**Due to the county’s fertile soils and favorable climate, agriculture** forms the backbone of the Nyandarua County economy. Their high productions of potatoes, cabbages, maize and beans that are sold in Nairobi and most other towns in the country have made to be considered as the ‘bread basket of Kenya”. Other crops that flourish in Nyandarua include carrots, kales, tomatoes and peas. **Livestock rearing** is also a major economic activity in Nyandarua. Farmers in the county engage in dairy farming, sheep rearing, beef production as well as poultry. These products are sold to traders from Nairobi and other neighboring towns.



Plate 1 Cabbage farm

### Transport and roads

Nyandarua county has a Bitumen Surface (297.3 Km), Gravel Surface (323.4 Km), Earth Surface (434.7 Km).

These roads facilitate the mobility of good, services and tourists from one destination to another.

### Health Facilities

The County has more than 100 healthcare facilities serving the residents of the county. Major hospitals in the county include Nyahururu District Hospital and JM Kariuki Memorial Hospital (formerly Ol Kalou District Hospital). **(**[**Kenya Information Guide Home page**](http://www.kenya-information-guide.com)**)**

### Education facilities, Religion and Traditional Culture

There are 471 primary schools and 149 high schools serving 149,209 pupils and 25,758 students respectively. The county's Teacher to Pupil Ratio is 1: 42 for public primary schools and 1:22 for public high schools.

It has several polytechnics and technical colleges including the Nyandarua Institute of Science and Technology though it has no university.

Majority of people living in Nyandarua County are Christians, with a small number of Muslims being present in major towns.

Top Christian denominations in the county include Roman Catholic, Anglican, PCEA, Assemblies of God and other protestant churches.

### Water resources and general water status

The major rivers in the county are:-

1. River Malewa
2. River Turasha
3. River Pesi
4. River Kitiri
5. River Kiburu
6. River Kinja
7. River Uaso Narok

These rivers originate from the Aberdare forest and drain into Ewaso-Nyiro and Nakuru in Rift valley and Tana catchment areas.

The county has one small lake, L. Elementaita 222 small dams and water pans, 280 boreholes, 6,244 shallow wells and 96 springs.

* + 1. **Nyandarua county water supply status**

1. Water status in urban centres

The county has seven urban centres namely:-

1) Ol' Kalou which is the county headquarters

2) Ol' Joro Orok- Sub county headquarters

3) Mairo Inya- Commercial center

4) Ndaragwa- Sub county headquarters

5) Miharati- Sub county headquarters

6) Engineer- Sub county headquarters

7) Njambini - Commercial centre

These urban centres with the exception of Miharati suffer from water shortages as they are served by schemes which have outlived their design lives and as a result their water demands have outstripped supply. Also they do not have sewerage services.

1. Water supply situation in the rural areas

25 % of households in the county have access to piped water, 35% access water from protected sources, while 40% access water from unprotected sources. Therefore, there is need to increase the number of households with access to potable water.

## Water services providers in Nyandarua County

There are two water companies in the county licensed by the Rift Valley Water Services Board. These are; the Nyandarua Water and Sanitation Company and the Ol’kalou Water and Sanitation Company. In addition The County has 106 CBOs operating in the different parts of the county serving a population of about 400648 persons.

Table 4.1 Water services providers in Nyandarua County; water source and service population (Nyandarua county report 2011)

|  |  |  |  |
| --- | --- | --- | --- |
| WSP | SOURCE OF WATER | POPULATION | |
| In Service Area | Served |
| Nyandarua Water and Sanitation Company | Kaheho, Pesi and Karurumo rivers | 77,999 | 51,802  (66.4%) |
| Ol Kalou Water and Sanitation Company | River Malewa and Bore holes | 67,392 | 16,522  (24%) |
| 14 CBOs | Rivers | 221,551 | 188,500  (85.1) |
| 92 CBOs | Rivers | 284,615 | 212,148(74.5) |
|  |  | 1,752,185 | 1,13371 |

Details of individual projects are outlined in the appendix 2

### Water and sanitation companies in Nyandarua

#### Management structure and supply technology

1. **Management structure**

The companies are managed by a board of directors made of members who are elected annually for example, Olkarou has board of directors comprising of five members and three corporate management members. The board of directors are elected after every three years in an annual general meeting. In addition to the board, the company have committees which oversee the day to day running of the company.

These committees include;

* Audit committee; this is employed to oversee the running of the project and to audit the various projects in the company. This is done to evaluate the success of the projects, viability of the several of the projects and the implementation of the project.
* The finance and personnel; this is the branch of the company that deals with the finances. It is the committee that makes key decisions in the company concerning allocation of funds to the various projects reporting to the board. They also oversee the collection tariffs, regulating tariffs.
* The technical committee; these are employed to oversee the installation and maintenance of the various utility to ensure efficient supply to consumers. They install and maintain the water meters, the design and installation of the pipeline system, storage tanks and also repair of pipe bursts, pump break down among others.

The companies are both operational and are supplying water to the residents of Nyandarua. The companies are licensed waters services providers by the Rift Valley Water Services Board.

1. **Technology of water supply**

The companies have employed various modes of water supply. They use both pumping using electricity and also gravity depending on the location of the water source.

When abstracting from the rivers, there is use of gravity while from boreholes, mostly pumping is done. When drawing water from the boreholes and supplying it to flat areas within the area of operation, pumping is done.

A good example is the Olkarou Water and Sanitation Company that uses gravity flow to deliver water abstracted from rivers and pumping for the wells and boreholes in Olkarou town.

The companies have also established various water points inform of water kiosks where the consumers not individually connected water can pay and draw water.

#### Challenges faced by the companies in the bid to supply clean water

* Non-revenue water.

The amount collected from the amount of water billed is much less than the amount of abstracted water. For instance, it accounts for about 70% in OLWASCO.

This has been heightened by dilapidated water supply mechanisms which lead to breakages and pipe burst. Also, the residents fail to pay for the water service provided forcing the company to disconnect the links hence increasing on cost. Poor water distribution network leading to high un accounted for water, Lack of consumer meters hence inaccurate billing and low revenue collection

* Inadequate source of water. For example, in the case of OLWASCO, Water is not enough as 25 groups abstract water from river Malewa. During the dry spell, the community of the 24 groups depends on the water for irrigation and they don’t have 90 days storage.
* Low water quality. The companies offer to the residents raw water from the river and the boreholes because they lack a water treatment plant. This can lead to the transmission of waterborne diseases to the residents of the town.
* Lack of laboratory facilities for water quality monitoring and control
* The companies suffer the challenge of inadequate storage facilities making it difficult to store enough water for a continuous supply from the source to the consumers. For this reason, the companies are forced to supply water for specific days in a week to the residents.
* Lack of sewerage system and treatment plant in the town to deal with the challenge of waste water.
* Inadequate transport facilities making delays when doing the maintenance works
* There is poor planning of the towns and residential plots and hence the companies are not able to map the networks for the laying down of the piping system

### Community based organisations in Nyandarua County

#### Management structure and supply technology

The organisations are owned by communities. Some are registered by the Rift Valley Water Services while others are registered by the District Water Office (DWO).

Some service providers are managed and are under Nyandarua Water Company while others run independently. The following table is a summary of the various CBOs, their location, management structure and their respective supply technology.

Table 4.2 Management, water supply source and technology of water projects

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| DISTRICT | TOTAL GROUPS | MANAGEMENT | | TECHNOLOGY OF SUPPLY | | STALLED PROJECTS |
|  | | COMMITTEE | NYANDAWAS | PUMPING | GRAVITY |  |
| Nyandarua North | 8 | All | none | 2 | 6 | None |
| Nyandarua west | 9 | 8 | 1 | 8 | 1 | 1 |
| Nyandarua central | 14 | 11 | None | 12 | 2 | 3 |
| Mirangine | 5 | all | None | All | None | None |
| Nyandarua south | 17 | all | none | None | All | None |
| Kinangop | 7 | all | None | 1 | 6 | None |
| Kipipiri | 44 | All | None | None | All | None |

#### Challenges facing community based organisations

According to the study evaluation, the following challenges were observed among the Community Based Organizations in the bid to supply continuous supply of water to their respective service areas.

* Insufficient funds to upgrade their pipeline systems, meters to the consumers and to hire enough labour. This has led to increased inefficiency in operation.
* Old infrastructure- most of the projects were initiated in the 1980s and hence the infrastructure installed then has grown old. It is no longer efficient.
* Increased cost of electricity and diesel. This is particularly to those service providers who use pumping as their technology of water supply to the consumers.
* Increased levels of Non-revenue water. This has been heightened by the inefficient old pipes which burst and leak once in a while, lack of master meters and individual meters to measure the amount of water consumed.
* Leadership challenges. Most of these communities based organizations and self-help groups are managed by the committee among the locals of the community. Many haven’t hired skilled labour that will enhance efficiency and service delivery. This has many projects stalling and others being abandoned by the government.

Politics of the land; many of these projects are politicized hence depend on the politics of the area for their success. This has sled to many projects incomplete while others have stalled completely.

## Data collected on representative WSPs in Nyandarua.

### Olkarou water and Sanitation Company

Olkarou town is the county headquarters. The town is served by the OLWASCO and therefore there was a need to give it a closer study. Questionnaires were administered and crucial information was obtained.

#### Company details and history

Olkarou water services and sanitation company limited provides water to the town. The project which was started in 2006 and is licensed by the Rift Valley Water Services Board. The project is based in Nyandarua county, Olkarou sub-county. Though the company is wholly owned by the Nyandarua County Government and is commercially managed, the water tariffs are regulated by the Water Services Regulatory Board.

The company was started in the year 1973 as a pumping scheme. It only had one borehole situated at the centre of Olkarou town.

In 1993, the scheme borehole was rehabilitated by the Government of Kenya under the ministry of water and irrigation and continued to offer water to the residents of the town.

In 1st July 2006, the company took over and was licensed as an agent and water service provider by the Rift Valley Water Services Board with the principal objective of providing clean water and sewerage services to the town. Upon devolution in March2013, OLWASCO was now made to be under the Nyandarua County government

#### Water Services provision

The company is currently operational. It has five boreholes and one river source i.e. River Malewa. The company uses pumping method to draw water from the boreholes situated in Olkarou town. In addition, the company has abstracted water from River Malewa where gravity flow methods from the intake to the town is employed. This has gone a way ahead to reduce the pumping charges and increasing water supply to the residents of Olkarou town. The area covered by the company is 371km2 of which 10kms is in Olkarou town and 361km2 rural area covering Kaimbaga Olkarou, and Rurii wards .The project has however managed to cover 17 square kilometres. This means that quite a large area remains unserved by the company.

The company currently serves an estimated 28000 beneficiaries though the target is 80000 no people. These consumers are inclusive of them with individual connections from the distribution systems and those who draw water from the water kiosks in Olkarou town.

Among the beneficiaries from the company include;

1. J. M Kariuki Memorial Hospital; due to inadequate water supply and low water quality, the hospital relies on their own borehole.
2. Olkarou Dairy; also relying on their own borehole which has been expensive and hence adequate supply from OLWASCO would improve farmers income from the dairy products
3. Education institutions; including both primary and secondary schools with an estimated population of 6000 students.
4. Juakali sheds; who mostly use donkey carts from water transport from unhealthy sources
5. Residents for domestic uses.

#### Management structure

The company is managed by a board of directors comprising five members and corporate management of 3 members. The company is also governed by three committees with three members each namely the audit committee and the finance, technical and personnel committee.

The appointment for the board of directors is done once in three years.

The management of the company runs the day today affairs of the company. They respond to the issues that arise during the provision of water to the consumers.

For instance, the technical team has been tasked with the mandate of designing the water distribution systems, maintaining and repair of the piping systems and services provision utilities as well as the metering devices.

The finance committee is tasked with the responsibility of collecting the revenue by enhancing that the water tariffs are paid, ensuring that consumers pay for the services offered and the purchase of maintenance equipment used to repair the service provision systems.

The project challenges are as described in section 4.2.2.2

### Munyeki water project

This is a community based organization that has employed the use of solar power to pump water from the boreholes. This method has proved cheaper than using electricity or diesel as a method of pumping water from the boreholes.

Munyeki water project was initiated in 2001 and registered the same year with the social services Department. The project is in Nyandarua county Olkarou Sub County Munyeki village.

The project is owned by the community and hence considered as a community based organisation also registered with the Rift Valley Water Services Board.

1. **History of the project**

The idea of forming Munyeki water project arose after a local pastor invited a missionary and his wife from America to visit Munyeki village in the year 2001.

After their visit, the wife asked the women whether a dispensary would be of benefit to them but they opted for a water project due to the scarcity of the same as they wholly depends on dams and pans dug during the colonial times. She requested them to register a water group and acquire plots where a borehole could be drilled and send her the details.

After getting their details, she sent Kshs2, 500,000 to drill the borehole which was drilled and a 100M3 masonry tank constructed in the year 2005.

Later on in the year 2010, Rift Valley Water Services Board through the District Water Office Nyandarua Central gave the project 1,780,000/= to install a solar powered M-Pesa operated water system which was installed in the month of September 2010. Later, the missionaries gave another Kshs.800, 000 to install another solar unit to pump water to the masonry storage tank from where it will gravitate to the consumers. The government has further bought and laid pipes worth Kshs 1,400,000 making its total contribution to Kshs 3,180,000.

1. **Services provision**

The source of water is borehole, No C14434.The borehole was drilled in 2005. The yield of the borehole is 4m3/hr.

The project has employed the use of solar powered mechanisms for pumping the water from the borehole which is the channeled to the storage tanks. From the storage tanks, the water can then flow by gravity to the residents as the project is situated on a raised ground.

According to the study, it was found that the safe yield from the boreholes will give a safe yield of 64m3/hr. This yield is far much below what is required at ultimate stage when communal water points are considered.

The project is expected to serve an area of 8km2 to the members of the community. Currently consumers draw water from the borehole site through a water kiosk located at the boreholes vicinity. Revenue collection is through prepaid system using Mpesa.

**Observed achievements by the project**.

The community had achieved the following;

* Purchase of two plots ,quarter acre size
* Drilling one bore-hole
* Construction of one permanent storage tank
* A solar system for pumping water from borehole and main pipes laid down to main tank plus standby electricity
* Fencing around the borehole
* House for storing pump and tank around the borehole

The project has benefited households, 4 cattle dips, 3 primary schools, 12chrches, a health centre and secondary schools.

1. **Management structure**

The projects affairs are managed by a committee of 9 members. They are elected as per the project by laws.

The project also has by-laws which govern the members and each member is expected to abide by them.

The committee oversees the day to day running of the project. The project also has employed an attendant at the water kiosk to sell water within the project area to the consumers. Adoption of the programme by the government would help to improve and expand it to ensure it serves more people.

### Nyakanja self-help group

Specific interest in this project is that it has been given an SPA by the RVWSB and has upgraded from a community based organization to water and Sanitation Company.

The source of water for this project is a natural spring which ensures continuous supply of water both in dry and wet months.

Nyakanja water and Sanitation Company was started in the year 1999. The project which is in Nyandarua county Oljoro-orok Sub County is owned by the community and hence considered as a community based organisation also registered with the Rift Valley Water Services Board.

The project started as a self-help group with members contributing for the initial start-up capital. It was later funded by a donor (SIDA). The project started from 1994 to 1998 as a self-help group. From the year 2014, the project was upgraded to a water and sanitation company. It then reverted to the society who fund it through the services offered. The project has an SPA with the Rift Valley Water Services Board.

**Service provision and operation**

The projects source of water is a natural spring that runs continuously both in dry and wet seasons. Due to the location of the spring, water cannot flow by gravity and hence the project employs the use of pumping to supply water to the customers. The source of power in this project is electricity. This increases the cost of operation and hence the project fails to supply the water continuously to the residents.

The project covers three sub locations i.e. kiwanja, kanguo and Gatumbiro and four villages namely, Nyakariaga, Kiwanja, kianjata and kanguo.

The project has registered membership of 900 members though the active members are700.

The project is governed by a committee comprising of 9 members. The last elections were held on 8th may 2014 where the members were endorsed as trustees to the current Nyakanja water and Sanitation Company to serve as the directors.

The company has hired a manager and seven employees under him who oversee the day to day running of the project activities.

These include the maintenance of the pipeline system to ensure that the project provides a continuous supply of water to the community, operation and maintenance of the pump, installation and maintenance of water meters, advising the board members on major decisions of the project.

The team also oversees the collection of water tariffs from the members.

### Water project under Nyandarua Water Company- Itonyero - simbara - subuku

A study of this self-help group that is managed by NYANDAWAS was done. The project was started in the year 2001.

The project is in Nyandarua County, Ndaragwa Sub County and constituency. It is managed by Nyandarua Water Company and registered by the Rift Valley Water Services Board.

The project was started after a proposal presented to water services trust fund was done and funding arranged. Series of meetings between Nyandarua Water Company and the stakeholders from the project area were done. Finally the project was implemented and finished in 2001.

The project is currently operational. Its source of water is the river and the water flows by gravity to the consumers. The project serves Karai, Simbaka, and Sumbuku sublocations supplying water to a population of about 8021.

The project is managed by Nyandarua Water Company and hence adheres to the company’s code of practice.

The project face the following challenges

* Resistance from the local communities but was handled through a series of meetings
* Acts of vandalism to installations along the pipeline
* Insufficient labor for unskilled tasks

## Analysis and discussion of information for the different water service providers

### Water companies

The companies in the county have been allocated specific areas of operation by the RVWSB. The companies are licensed to offer water services to the residents as WSPs.

#### Service area of operation

Nyandarua Water and Sanitation Company has a service area covering a population of 79999 but has managed to supply water to a population of 51802. This represents 64% coverage.

Olkarou Water and Sanitation Company has a service area covering a population of 67392 but has supplied water to only a population 16522representing 26%.

The companies have an operation and cost recovery of 28% and 26% for NYANDAWAS and OLWASCO respectively according to the data collected from the companies’ records.

The companies provide water to the consumers by piping systems and also selling through specific water kiosks located at different locations within the area of operation.

The water tariffs for this water companies are regulated by the water services regulatory authority.

#### Management structure

The companies are managed by a board of directors. In addition, the companies have employed staffs who oversee the day to day running of the company’s affairs.

These employees include personnel, finance and auditing and the technical staff. These workers are paid from the proceeds of the company.

The companies do not suffer major governance wrangles and hence their management and hence efficiency in management. With the aim enhancing efficiency in operation and management of CBOs, it was found out that there has been a consideration that the water companies in the respective areas to manage CBOs in their areas of operation. This is to help improve their level of operations, management and efficient service provision.

Some committees for the projects had generally agreed to join the two existing water companies.

### Community based organizations (CBOS)

The various projects in the county employ different methods of water supply to the consumers. This is largely influenced by the source of water for the projects and the terrain of the land.

Projects drawing water from boreholes employ pumping methods as its supply technology. Other projects abstracting water from rivers mostly employ the use of gravity to draw water to the consumers which is cheaper and efficient as the water supplied to the consumers has sufficient pressure.

Pumping in most projects is by electricity though some use diesel. One of the inventions of solar powered method of pumping has been applied by Munyeki Water project. This has proved to be cheaper than other methods.

Projects in Nyandarua central, Mirangine and Nyandarua West districts majorly use pumping as their supply method to the consumers. This is influenced by the flat terrain of the areas. Projects in Nyandarua North, Nyandarua North, Kipipiri and Kinangop districts majorly use gravity as a method of water supply to the consumers. This is due to the topographical alignment of these regions that allows the flow of water by gravity.

Most of these organizations and self-help groups are funded by the community while others are funded by the government.

Other CBOS have been funded by interested groups and Nongovernmental organization as initiative to help the societies obtain clean water.

The CBOS are managed by committees who are members of the community elected by the members to spearhead the projects, oversee the implementation of the same. Some CBOs have employed some staff who runs the day to day affairs of the projects in terms of management and operation. These staff facilitates the collection of water tariffs, repairs and installation and advising the community accordingly through the committee.

The tariffs charged by the various projects differ from project to project. This depends on the agreement of the committee through a meeting.

The management of these organizations faces leadership crisis. Some of these wrangles are political where individual projects are politicized. This has led to stalling of some projects in the county. The members of the community lack sensitization on the benefits of paying the water tariffs on time and efficiently.

It has been proposed that all SHG water projects in Nyandarua be governed under the water companies as mentioned in Section 4.4.1. Unfortunately the community members also offer resistance to the implementation of various in the county. A good example being Itonyero-Subuku water project in Ndaragwa constituency, which is under the management of NYANDAWAS.

Some community based organizations though have agreed to work under the management of the water companies (as illustrated above) in the region and some are under the management of the companies. This will enhance efficiency of operation and management.

# CHAPTER 5

# CONCLUSIONS AND RECOMMENDATIONS

## Conclusion

The main objective of this study was to study the existing water service providers and the projects facilitating water service provision in Nyandarua County, determine the effectiveness of the water service providers in the county, identify the challenges facing the water service providers in their bid to provide clean water in the county and to study the effectiveness of the management of the projects that provide water to the residents of the county.

The objectives were met with the following major findings;

1. The county has two water companies i.e. Nyandarua Water and Sanitation Company and Olkarou water and Sanitation Company and 106 community based organizations, some registered as WSPs by the RVWSB and others by the social services departments to provide water to the communities.
2. The companies are managed by a board of directors who oversee the running of the companies. In addition to the board, the company has hired specialists who run the company on a daily basis. The companies’ headed by managing directors and the working staff ensure that continuous water supply is availed to the consumers.
3. Due to the structured form of management in the companies, the company’s management is fairly efficient and hence no leadership wrangles.
4. The companies are registered WSPs by the Rift Valley Water Services Board and each are assigned a service area.
5. The companies also employ both pumping and gravity as a technology of water supply. Where water is drawn from boreholes, pumping is used to raise water to higher grounds where it can flow by gravity. Where terrain allows, water is supplied by the flow of gravity.
6. The major challenges facing the companies in the bid to provide water to the consumers include, the challenge of non-revenue water, inadequate storage facilities, lack of treatment plants hence forced to supply untreated water which may lead to spread of water borne diseases, the companies have insufficient funds to expand their water supply systems including pipelines and water meters. Lack of sewerage systems in the county also is a major drawback and challenge to the communities.
7. The service areas supplied by the companies are very limited compared to their areas of operation that have been assigned by the RVWSB.
8. The CBOs are managed by the committees that are elected by the community members to oversee the day to day running of the projects. Some projects have reported cases of mismanagement and leadership wrangles which have led to the stalling of some projects.
9. The CBOs have insufficient funds to ensure efficient supply of water and hence serve limited areas serving low populations. Low water tariffs also have contributed to the organizations strain financially.
10. The service areas assigned to the water service providers also overlap each other and therefore conflicts arise between the service providers. The members of the community fail to remit their bills leading to disconnection of the system. This is an extra cost to the service providers.

Though there has been significant steps made by the available water service providers in the county, the challenge of water supply still remain rampant. This is mostly in the districts of Nyandarua Central, Nyandarua North, Nyandarua East and Mirangine. These areas have a fairly flat terrain and the water has to be pumped to the consumers. The districts Nyandarua south, Kipipiri, Kinangop and Nyandarua West employ mostly gravity as a technology for water supply. This reduces the cost of water provision and such, these areas are well watered.

## Recommendations

To address the challenge of water services provision in the county, the study found the following recommendations necessary to the companies.

1. Installation of water treatment plants to ensure that they supply safe drinking water to the consumers
2. Installations of modern water supply systems which are efficient to help deal with the challenge non-revenue water.
3. Supervising the management and operation of CBOs to ensue efficient supply of water to the communities.
4. Sensitization and capacity building to the members of the community to ensure that they embrace the projects installed for them in the areas targeted.
5. Local politicians should avoid politicizing development projects to ensure there is proper implementation.
6. Development programs should be consolidated at county level to avoid fragmented development
7. Use of modern modes of water charging e.g. the use of Mpesa prepaid systems for water sold. This will help deal with the challenge of Non-revenue water.

The recommendations to the community based organizations according to the study were;

1. Merging the CBOs to be under the management of the water companies in the county. This will solve the challenge of management issues improving on their efficiency.
2. Raising water tariffs to a cost that will ensure that their operational and maintenance cost are met. This will enhance service delivery.
3. Sensitization to be done to the members of the community to emphasize the need to own up the projects, pay the water charges and guard the facilities.
4. Community members to group themselves into self-help groups and initiate water projects in their localities. This will ensure a wider coverage in the area of service provision.
5. The various CBOs to employ other sources of power for pumping for example the use of solar powered method of pumping. This will help reduce on the operational cost as electricity and diesel are expensive.
6. Sensitize the members of the community on the need for the installations of meters ensure that water used is accounted for. This will raise the revenue and solve the problem of non-revenue water.
7. Adoption of the various projects by the county and national governments to ensure funding of the projects.
8. Revival of the stalled projects though efficient management.

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# APPENDICES

## Appendix 1

**MAP OF PROJECT AREA**

## Map Showing study area



## Appendix 2

## Water projects in Nyandarua County

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **District** | **Project no** | **Project name** | **Status** | **Water abstraction(m3/day)** | | **No. of consumers** | **Technology of supply** |
|  |  |  |  | Authorized | actual |  |  |
| Nyandarua north | 1 | Kirima | O |  |  |  | Gravity |
|  | 2 | Leshau | O |  | 80 | 280 | Pumping |
|  | 3 | Ndaragwa | O |  | 3208 | 836 | Gravity |
|  | 4 | Gathuka | O |  |  |  | Gravity |
|  | 5 | Gathariga | O |  | 185 | 1613 | Gravity |
|  | 6 | Kanjuiri | O |  | 328 | 1105 | Gravity |
|  | 7 | Githunguchu | O |  |  |  | Pumping |
|  | 8 | Gathima | UI |  | 341.46 |  | (Gravity)UI |
|  |  |  |  |  |  |  |  |
| Nyandarua west | 1 | Gatimu | O |  | 250 | 886 | Pumping |
|  | 2 | Ol Joro Orok Kangui | O |  | 257 | 1019 | Gravity |
|  | 3 | Kariko | O |  | 29 | 400 | Pumping |
|  | 4 | Weru | O |  | 15 | 86 | Borehole |
|  | 5 | Kisawel | O |  | 4180 | 300 | New project nearing completion |
|  | 6 | Ex Jacob | O |  | 100 | 80 | Pumping |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **District** | **Project no** | **Project name** | **Status** | **Water abstraction(m3/day)** | | **No. of consumers** | **Technology of supply** |
|  |  |  |  |  |  |  |  |
|  | 7 | Nyakanja | O |  | 200 | 650 | Pumping |
|  | 8 | Ex Meja | PF |  | - | - | New project under construction |
|  | 9 | Kasuku | PF |  |  |  | Pumping |
| Nyandarua central | 1 | Ol kalou | O | 1200 | 600 | 3350 | Gravity |
|  | 2 | Mugumo | O | 102 | 75 | 165 | Pumping |
|  | 3 | Munyeki | POF | 154.5 | 20 | 1000 | Water from a kiosk(Pumping) |
|  | 4 | Muiri | PIF | 119.6 | - | - | Pumping |
|  | 5 | Kaimbaga | POF | 196.8 | 50 | 700 | Pumping |
|  | 6 | Rurii | POF | 360 | 30 | 600 | Water from kiosk(Pumping) |
|  | 7 | Manyatta | SO | 300 | - | - | Pumping |
|  | 8 | Gikumbo | DF | 52.7 | - | - | Pumping |
|  | 9 | Passenga | SOP | 140 | 12 | 500 | Pumping |
|  | 10 | Silanga | SO | 138 | 30 | 400 | Pumping |
|  | 11 | Mawingu Kagaa | UI | 240 | - | - | Pumping |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **District** | **Project no** | **Project name** | **Status** | **Water abstraction(m3/day)** | | **No. of consumers** | **Technology of supply** |
|  |  |  |  |  |  |  |  |
|  | 12 | Githima | POF |  |  |  | Gravity |
|  |  |  |  |  |  |  |  |
|  | 13 | Shalom | POF |  |  |  | Pumping |
|  | 14 | Githunguri | DF |  |  |  | Pumping |
|  | 15 | Ngorongo | O |  |  |  | Pumping |
| Mirangine | 1 | Ngorika | O |  | 150 | 600 | Gravity system, raw water |
|  | 2 | Gitirima | UI |  | 88 | 2000 | 98% complete  (Gravity) |
|  | 3 | Gwa Kiongo | UI |  | 250 | 2500 | Pumping system. |
|  | 4 | Kimiti BH | O |  |  |  | Pumping |
|  | 5 | Uhuru borehole | UI |  | 240 | 50 | Pumping |
| KIPIPIRI | 1 | Mawingu | O |  | 210 | 670 | Gravity |
|  | 2 | Manunga mahinga | “ |  | 56 | 550 | Gravity |
|  | 3 | Gitei | “ |  | 234 | 500 | Gravity |
|  | 4 | Magomano | “ |  | 123 | 80 | Gravity |
|  | 5 | Mikeu | “ |  | 13.2 | 250 | Gravity |
|  | 6 | Kagongo | “ |  |  | 60 | Gravity |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **District** | **Project no** | **Project name** | **Status** | **Water abstraction(m3/day)** | | **No. of consumers** | **Technology of supply** |
|  |  |  |  |  |  |  |  |
|  | 7 | Safi | “ |  | 44.2 | 30 | Gravity |
|  | 8 | Thome | “ |  |  | 40 | Gravity |
|  | 9 | Chebuthwa | “ |  |  | 30 | Gravity |
|  | 10 | Mukuru | “ |  |  | 80 | Gravity |
|  | 11 | Kahiga | “ |  |  | 25 | Gravity |
|  | 12 | Kangiri | “ |  |  | 35 | Gravity |
|  | 13 | Muroha | “ |  |  | 15 | Gravity |
|  | 14 | Malewa | “ |  |  | 300 | Gravity |
|  | 15 | Nyagathuru | “ |  |  | 125 | Gravity |
|  | 16 | Rugongo | “ |  |  | 30 | Gravity |
|  | 17 | Ruara | “ |  |  | 50 | Gravity |
|  | 18 | Mwireri | “ |  |  | 36 | Gravity |
|  | 19 | Kinungu | “ |  |  | 120 | Gravity |
|  | 20 | Upper Malewa | “ |  |  | 500 | Gravity |
|  | 21 | Kipipiri Integrated | “ |  |  | 2435 | Gravity |
|  | 22 | Muthangira | “ |  | 56 | 300 | Gravity |
|  | 23 | Mubando | “ |  |  | 25 | Gravity |
|  | 24 | Munanda | “ |  |  | 36 | Gravity |
|  | 25 | Gitwe | “ |  |  | 45 | Gravity |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **District** | **Project no** | **Project name** | **Status** | **Water abstraction(m3/day)** | | **No. of consumers** | **Technology of supply** |
|  |  |  |  |  |  |  |  |
|  | 26 | Mutamaiyu | “ |  |  | 65 | Gravity |
|  | 27 | Baraka | “ |  |  | 25 | Gravity |
|  | 28 | Mutarakwa | “ |  |  | 80 | Gravity |
|  | 29 | Thome | “ |  |  | 35 | Gravity |
|  | 30 | Kuga na Gwika | “ |  |  | 55 | Gravity |
|  | 31 | Muiri | “ |  |  | 25 | Gravity |
|  | 32 | Huhirio |  |  | 40.09 | 115 | Gravity |
|  | 33 | Kangiri |  |  |  | 35 | Gravity |
|  | 34 | Gathuru | “ |  |  | 45 | Gravity |
|  | 35 | Mahigaini | “ |  |  | 65 | Gravity |
|  | 36 | Ihiga | “ |  |  | 45 | Gravity |
|  | 37 | Muhonia Turasha | “ |  |  | 30 |  |
|  | 38 | Rotuba | “ |  |  |  | Gravity |
|  | 39 | Mwiteithia | “ |  |  |  | Gravity |
|  | 40 | Kianda | “ |  |  |  | Gravity |
|  | 41 | Githunguri | “ |  |  |  | Gravity |
|  | 42 | Mubondo | “ |  |  |  | Gravity |
|  | 43 | Munyaka | “ |  |  |  | Gravity |
|  | 44 | Witeithie | “ |  |  | 35 | Gravity |
| Nyandarua south | 1 | Engineer | “ |  | 300 | 806 | Gravity |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **District** | **Project no** | **Project name** | **Status** | **Water abstraction(m3/day)** | | **No. of consumers** | **Technology of supply** |
|  |  |  |  |  |  |  |  |
|  | 2 | Muhonia Turasha | “ |  | 42 | 770 | Gravity |
|  | 3 | Githima BH | “ |  |  |  |  |
|  | 4 | Laigiri | “ |  | 30 | 314 | Gravity |
|  | 5 | Kinja | “ |  | 31.58 | 656 | Gravity |
|  | 6 | St Mary | “ |  |  |  |  |
|  | 7 | Kikanamku | “ |  | 133 | 1317 | Gravity |
|  | 8 | Raitha Kahuru | UI |  |  |  | Gravity |
|  | 9 | Tulaga Muruaki | “ |  | 100 | 650 | Gravity |
|  | 10 | Tulaga Ngwataniro | “ |  | 43.7 | 300 | Gravity |
|  | 11 | Mutamaiyu | “ |  | 40 | 500 | Gravity |
|  | 12 | Tia Wira | “ |  | 80 | 462 | Gravity |
|  | 13 | Kairia Gitite | “ |  |  |  | Gravity |
|  | 14 | Mukungi Mumui Mikaro | UI |  |  |  | Gravity |
|  | 15 | Gatamaiyu | O |  |  | 30 | Gravity |
|  | 16 | Githai | “ |  |  | 250 | Gravity |
|  | 17 | Mwihoko | “ |  |  | 130 | Gravity |
| Kinangop | 2 | Kamurembo | “ | 60 | 27 | 61 | ,, |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **District** | **Project no** | **Project name** | **Status** | **Water abstraction(m3/day)** | | **No. of consumers** | **Technology of supply** |
|  |  |  |  |  |  |  |  |
|  | 3 | Upper Chania | “ | 1000 | 1000 | 1140 | ,, |
|  | 4 | Kiburu | “ | 92.9 | 70 | 148 | ,, |
|  | 5 | Karuang’i | “ | 458 | 200 | 360 | ,, |
|  | 6 | St Luke Nyakio | UI |  |  |  | Gravity |
|  | 7 | Kibuyu/ Magumu BH | PIF | 20 | 20 | 50 | Pumping |

## APPENDIX 3:

## SAMPLE QUESTIONNAIRE

**OPEN ENDED QUESTIONNAIRE**

**RESEARCH PROJECT: ROLE OF WATER COOPERATIVES IN KENYA**

**RESEARCHER: ANTONY NJOROGE**

**1. WATER PROJECT NAME**

**……………………………………………………………………………………………………………………………………………………………**

**2. YEAR OF INCEPTION**

**……………………………………………………………………………….............................................................................**

**3. LOCALITY**

1. **Water Services Board**

**…………………………………………………………………………………………………………………………………………………**

1. **County**

**………………………………………………………………………………………………………………………………………………**

1. **Constituency/Sub County**

**…………………………………………………………………………………………………………………………………………………**

**4. NATURE OF PROJECT (tick where applicable)**

1. **Self Help /CBO**
2. **Cooperative**
3. **Other**

**5. FUNCTIONAL STATUS I.E. OPERATIONAL/NOT OPERATIONAL**

**……………………………………………………………………………………………………………………………………………………………**

**6. PROJECT DESCRIPTION**

1. **How was the project started/History of Project**

**…………………………………………………………………………………………………………………………………………………**

1. **Source(s) of Water (e.g. borehole, river etc)**

**…………………………………………………………………………………………………………………………………………………**

1. **Supply Technology (e.g. pumping, pipeline etc)**

**…………………………………………………………………………………………………………………………………………………**

1. **Coverage area ( e.g. Villages, sub locations covered)**

**………………………………………………………………………………………………………………………………………………**

1. **Number of Beneficiaries**

**…………………………………………………………………………………………………………………………………………………**

1. **Management**
2. **Type (e.g. committee etc)**

**………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………….**

1. **Number of committee members if any**

**…………………………………………………………………………………………………………………………………….**

1. **Last elections and Last AGM (Year)**

**………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………….**

**7. PROJECT CHALLENGES**

* **……………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………**

**8. RECOMMENDATIONS/SOLUTIONS**

* **……………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………**
* **…………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………**

**Filled by;**

**Name……………………………………………………………………………………………………………………………………………………**

**Designation…………………………………………………………………………………………………………………………………………..**

**Mobile phone number………………………………………………………………………………………………………………………….**

## APPENDIX 4;

## Filled questionnaires

## Appendix 5

**PHOTO GALLERY**



Site for construction of Gatimu water supply



Nyakanja water supply source

**

Water kiosk under construction – Uhuru water project in Mirangine district



Consumer tapping water from a pipe system.



Water pump – Nyakanja water project