FACTORS AFFECTING PROVISION OF WATER BY NANYUKJ WATER AND SEWERAGE COMPANY

By

STEPHEN MUTEITHIA WANGUI

P. O. Box 92
KIKIIYII

A RESEARCH PROJECT RFPORT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF THE DEGREE OF MASTER OF ARTS IN PROJECT PLANNING AND MANAGEMENT, OF THE UNIVERSITY OF NAIROBI.

2012

DECLARATION

This research project report is my original work and lias not been submitted to any other college or university for academic Award.

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Stephen Muteithia Wangui

L50/60526/2010

This research project report has been submitted for examination purposes with my approval as a university supervisor.

Signature: Date: ^ O l

Esther Magambo

Lecturer,

School of Continuing and Distance Education

University of Nairobi.

DEDICATION

This work is dedicated to my loving wife Nancy and daughters Vivian, Rita, and Risper, for their patience in sacrificing their social interaction time during this research project.

ACKNOWLEDGEMENT

I acknowledge the input of my supervisor Esther Magambo who helped in developing this research project. I have been greatly impressed by her thoughtful comments and suggestions and her willingness to offer frequent inentorship in guiding this research project.

I would also wish to recognize the encouragement and inspiration by my wife Nancy Muteithia during entire duration of developing this research project.

I also wish to acknowledge my classmates who through constructive critique and encouragement contributed greatly as I developed this research project.

LIST OFTABI KS

LIST OF ABBREV I ATION

DOW	Drawers of Water
MWI	Ministry of Water and Irrigation
MDGs	Millennium Development Go;ils
NGOs	Non Governmental Organizations
NAWASCO	Nanyuki Water and Sewerage Company
NWSB	North Water Service Board
WSB	Water Services Board
WSRB	Water Services Regulatory Board
WSPS	Water Service providers
GOK	Government of Kenya
WFD	Water Framework Directive
EWA	European Water Association
WSSCC	Water Supply and Sanitation Collaborative Council
GWCL	Ghana Water Company Limited
NCEA	National Center for Engineering in Agriculture
UNDP	United Nations Development Programmes
ADB	African Development Bank
UNESCO	United Nations Educational Scientific and Cultural Organization
APHRC	African Population and Health Research Centre
NSTC	National Science and Technology Council
WD	Water Demand
UNEP	United Nations Environmental Programme
DWI	Drinking Water Inspectorate

ABSTRACT

This study investigated the factors that affect the provision of water by Nanyuki Water and Sewerage Company (NAWASCO) Among the variable reviewed included storage and conveyance, efficiency in revenue collection, increased demand for water and illegal connections. The study used both quantitative and qualitative approach to enable better interpretation of the result. The target population was drawn from three estates within Nanyuki municipality which took care of estates with high population density, medium and low density; which is a representative sample of the consumers. Purposive selection of an estate was done to capture such factors as owner occupation; systematic random sampling was then done to select the respondents Primary data was collected through self administered questionnaires with open ended and closed questions. Descriptive statistics such as the mean, standard deviation and frequency distribution were used to analyze qualitative data. The quantitative data was analyzed using Statistical Package for Social Science (SPSS) and multiple regression models used to summarize and facilitate comparison of variables. Tables were used to summarize responses for further analysis and response rate was 89%. The study found out the four studied variables affect provision of water by 60.2%. The study concluded that loss of water through conveyance and storage affected provision of water to a great extent, illegal connection to a great extent. The study also concluded that efficiency in revenue collection affected provision of water to a medium extent while increased demand for water was to a very great extent. The study recommends that NAWASCO should improve on customers complaints to lack of water. The study also recommends that NAWASCO should improve on field surveillance to minimize loss of water through illegal connections. The study also recommends that NAWASCO facilitates payment of bill through Banks and other money transfer services. Finally the study recommends that NAWASCO improve on water abstraction and storage to meet the ever growing demand for water. The study recommends further studies to be done on effects of commercialization, influence of source of water and social economic factors affecting provision of water

CHAPTER ONE

INTRODUTION

1.1 Background of the Study

The reliability of piped water supply has declined over the last 30 years .In part because of the inability of the government authority to provide adequate services and of rising populations particularly in urban areas which impose extra stresses, on supplies. Water security affects many regions of the world (DOW II, 1997).Back in 1960s there seemed to be few facts available about water supply in Africa and much of developing world ,this have been subject of vast and wide ranging research effort for at least four decades (DOW, 1997).

Millennium Development Goals **(MDGs)** can easily be achieved if provision is concentrated in urban areas mostly slums and pen-urban areas .This would get Africa on track to meet **MDGs** A status overview carried out in December 2006 in sixteen Africa countries which included, Benin, Burkina Faso. Madagascar, Malawi, Mauratania, Mozambique, Niger, Rwanda, Senegal, Tanzania. Uganda, DRC, Ethiopia, Ghana, Kenya and Zambia show that few of these countries are prepared to take key challenges of the sector. Most of them lack the capacity required to meet national and global targets (Kisima, 2009).

In Malaysia the infrastructure has been strained by rapid urban growth and there is high need for improvement of amenities such as water supply, Electricity, transportation, environment and drainage (Weng, 2006). In 2005, the federal constitution transferred all matters related to water supply services from stale list to concurrent list (Shawahid, 2007).This enabled the Federal government involvement in the water services sector and to establish regulated water services industry Presently existing water supply has improved but the demand is increasing due to population growth.

In Kenya the government has embarked on reforms in the water sector under the framework of the Water Act 2002(GOK, 2002). The Ministry of Water And Irrigation

(MW1) is spearheading the implementation pii" .s to address the problems associated with access and provision of water services I IK- Water Service Regulatory Board (WSRB) has been established to regulate Water and Sewage Services including development and maintenance of quality standard' and insurance of licences for service provision.

The Water Services Board (WSB) is responsible lot the regulation of water and sewage services within their prescribed areas of jurisdiilmn under license from WSRB. Their responsibility include holding or licensing and developing water assets, constructing Water Service Providers (WSPs) who are Ihe main igents in provision of water services and preparing plans for improvement of services including coverage and reviewing of tariffs. The WSPs may be community groups, Nou < lovernmental Organizations (NGOs), private companies including those set by local uithorities for specific purpose of operating water services. In attempt to address the pioblem of supply, commercialization which involved three towns Nyen, Eldoret and Kern ho was piloted before the water Act (2002) came into force.

Prior to the passing of water Act 2002 the supply of water to Nanyuki town and its environs was the sole responsibility of Nanyuki municipal council. However, following the passing of the Act in 2002 this role was relinquished by the council and all the council related assets passed over to the Northern Water Services Board (NWSB) to manage, this was affected on 6^{lh} June 2006. The NWSP in turn leased these assets to Nanyuki Water and Sewerage Company (NAWASCO) in accordance with the Act NAWASCO is mandated to serve consumers within Nanyuki municipality and adjacent areas of Meru (Katheri area) and Nyeri (Ichuga). On enacting of the water Act (2002) and becoming effective on $18^{.h}$ March 2003, it was expected that with clear roles and responsibilities for the sector, actors' performance would improve. Most of WSPs have not yet achieved the level of provision of service desired by their consumers. There is still a disconnect between the expected benefits of comniei lalization and the level of services currently in place.

1.2 Statement of the Problem

The resident of Nanyuki municipality and its en\ nonment still experience frequent water shortages even after commercialization. The study aimed at investigating factors that affect provision of water by Nanyuki Water and N.-werage Company (NAWASCO). The world is facing serious water crisis, the problem < I access and service delivery is more acute in developing countries The enormou volume of water and extensive infrastructure required to fulfill urban water demand have frequently exceeded the ability of government to provide secure supplies and h i e also created severe environmental problems (Drakakis, 2000). The water access mods to be improved drastically and urgently; especially if improvement has to be realiz.-d in the fight against poverty, hunger and diseases (United Nations, 2003).

About 1.3 billion people of the third world have no .iccess to adequate safe water (Bosch, 2006) while approximately 2.2 million people in developing countries die each year from diseases associated with lack of access to clean water. The Water crisis in Kenya is disrupting social and economic activities throughout the country. Unfortunately, the current wave of drought and water shortages in Kcnva and the rest of East Africa is only expected to continue (Alubbe. 201 1). The water cusis is due not only to the wave of drought, but also to poor management of watei supply, under investment, unfair allocation of water, rampant deforestation, pollution of water supplies by untreated sewage and a huge population explosion (Alubbe. 2(M 1).

1.3 General Objective of the study

To investigate the factors that affect provision of wain- by Nanyuki Water and Sewerage Company (NAWASCO).

1.4 Specific Objectives of the study

1. To establish how loses in storage and conveyance affect provision of water by Nanyuki Water and Sewage Company (N A WASCO).

2. To determine how prevalence ol illegal wak-r connection affect provision of water by Nanyuki Water and Sewerage Company t NA WASCO).

3. To establish how revenue collection efficii ncy affect the provision of water by Nanyuki Water and Sewerage Company (N \ WASCO).

4. To determine how increase in demand foi water affect provision of water by Nanyuki Water and Sewerage Company (NAWASCO)

1.5 Research Questions

1. To what extent does loss of water through storage and conveyance affect provision of water by NAWASC\>'‚

2. To what extent does the prevalence of illegal water connection affect provision of water by NAWASCO?

3. How does the efficiency in collection of revenue affect the provision of water by (NAWASCO)?

4. How does the increase in demand for water affect provision of water by NAWASCO?

1.6 **Significance of the study**

The study was timely as it would provide an insight to water service companies on challenges and approaches to deal with those challenges to become successful and sustainable commercial water providers The findings would also enable commercial water providers to be aware of the growing customer needs and plan for the rapidly growing demand for water. The study would also bring to the attention of the ministry of water and imgation some of the basic issues which need to be addressed to improve supplies sustainability. The consumer's awareness would also be aroused by the study. The results of the study would be important to researchers and scholars, as it would fomi basis for further studies.

1.7 Limitation of the Study

The study was earned out in Nanyuki and yei iliere are many other water service providers in other parts of Kenya. Although the inlormation may be generalized to other water service companies, this may not he absolutely correct as these companies operate under different environments and circumstances I lie cost of canying out the study was also substantial and may have affected the data colli (lion.

1.8 Delimitation of the Study

The study did a thorough review of other studies mi provision of water under different environments and made generalizations. A proper budget was made available minimizing on cost without effecting the quality and scope of the study.

1.9 Assumptions of the Study

The following were the assumptions of the study:

1. That the time scheduled and budget would cover the proposed study.
2. That the NAWASCO would allow the access lo iheir current records and all other related records.
3. That factors affecting provision of water by N \ WASCO applies to all other water providers In Kenya.

1.10 Definition of the Key Terms

Area of Jurisdiction:This is **an area** where the company operations are limited to; or conduct its business

Commercialization ft entails change in resouii management practical institutional change and introduction ol commercial principles such as efficiency cost benefit assessment and profit maximization.

Contracting: This is awarding of work through an official written agreement.

Efficiency and effectiveness: Efficiency is concerned with doing right while effectiveness refers to doing ihe right things even more than performing them efficiently

Illegal connection: Any connection to the supply line which is not authorized, example by passing a meter

Privatization: It entails organizational change

Provision: This is the act of supplying people with water.

Revenue: This is the amount of the money the Government receives from taxes or a company receives from us business.

1.11 Organization of the study

This research project report is organized in five t h.ipters. Chapter one forms part of the introduction of the study and illustrates the background of the study, the statement of the problem, objectives of the study and research questions.

Chapter two contains literature review; this is divided into two sections, Empirical and conceptual framework. The Empirical review is composed of past studies which are related to provision of water The conceptual framework contains the four variables and their relation to the provision of water.

Chapter three explains the research methodology This chapter outlines the research design. Target population, Sampling procedure. Data collection instrument and shows how the data was analyzed. The variables were also operationalized in this chapter. Chapter four contains data presentation, analysis and interpretation while chapter five contains summary of the Findings, Discussions, Com lusions and Recommendations. The references mostly contain the journals reviewed ami other sources such as books and websites. There are two Appendices; Introduction It-ltei and Questionnaire.

CHAPTER TWO

LITERATURE RI VIEW

2.1 Introduction

This chapter explore the past research studies on water provision. It provides an overview of some of the scholarly contributions 0l1 the field of water management and factors affecting it. The specific areas covered here are empirical review and conceptual framework.

2.2 Market Environmentalism in water supply in England and Wales

Water supply management has undergone a dramatic transformation in England and Wales over the past decades. According to Karen Bakker (2000), the privatization of the industry in 1989 passed the ownership from nationalized monopolies to private companies listed in the London stock exchange. The market based regulation has also displaced direct government management systems. Demand management is prioritized over dam building. The new way of doing things has also diversified engineering expertise and supplemented by that of economists and environmental scientists. Water is no longer perceived to be universally abundant; areas of water scarcity have disappeared, regional cross-subsidies have dwindled (DEFRA 2001 b, E.A2001; DWI, 2003).

Some political Economists focus on political economic of privatization of water supply, and see the process 'accumulation dispossession . The enclosure of public assets by private interests for profits, resulting to greater social inquiry (Harvey, 2003). Privatization entails change of ownership or handover of management from public to private sector. Commercialization entails change in resource management practices that introduce commercial principles (such as efficiency), methods (such as cost benefit assessment) and objects (such as profit maximization). (Ley, 2011).

Privatization thus entails organization change; in distinction from commercialization which entails institutional change (in the sociological sense of rules, norms and customs) privatization can occur without full commercialization, as with case with many water

companies in developing countries. Where private for profit companies operate tariff structures, that price water on a below marginal cost thus basis to initiated prior to privatization or while ownership is retained in the public sector (Bakker, 2003).

Private sector resources are proving increasingly important in enabling developing countries to meet growing demand for municipal services, particularly now that the central government funds and municipal revenues are becoming scarcer. Gabriel Ruth (1987), in his paper, the private provision of public services noted that private sector has substantial resources to offer, including funds for investment and management expertise to improve productivity and organizations efficiency. He viewed private sector participation as a likely option in improving the water and sanitation sector's performance.

2.2.1 Cost Recovery in provision of water

Any strategy for private sector participation must take its direction from market forces, recognizing that private investment is most appropriate in undertakings where consumers can bear full cost of recovery, Such as industrial development, tourism and high- income housing. The strategy must also take into account the implications of current acctoi policies, on cross subsidies. Often water and sanitation agencies rely on high volume and high income users to subsidize the cost of service to other consumers. The household willingness to pay for services, age, educational level, time for water availability, household expenditure and availability of water provision are significant factors that influence the households willingness to pay for improved water services. The implication is that the characteristic that influence their willingness -to-pay for improved water supply services. They can afford to pay higher than existing tariff if they are provided with the improved water service (Bolarinwa and Funke, 2011) Willingness to pay generally refers to the economic value of a good to a person (or household under given condition (ADB, 2007). The simple neoclassical-economic theory provides necessary .elements to model the decision process of a household's choice of water supply sources and this is based on specification of the utility function (Fisher, 1996): Hanemann. (1991).

2.2.2 Sustainable Water Service Delivery in the World

Many water developments in Indonesia were not successful in era 1970-2000. There was also less acceptability of new technologies which led to development failures in some developing countries (Cartel, 1999), Brikkle and Bredero, (2003), Lenton and Wright (2004), the constraints of success of water supply were lack of fund for procurement of facilities and cost of operation and maintenance. These constraints cause many people not to have water services.

In the study carricd out to predict sustainability, Bosch (2006) reported that 1.3 billion people of the third world had no access to adequate safe water. The study looked at availability of water sources, selection of technology, investment cost, existence and ability of operator, availability of spare parts, operation cost and community participation. It clearly reveals that for sustainable water supply to be achieved all the above factors must be addressed and the best of each is achieved. In Nigeria water supply is a state responsibility, to achieve its objective, the state responsibility, to achieve its objective the state has created State Water Agencies (SWAs) - Water Boards and water corporations to manage and operate systems for water service delivery in all urban and semi-urban areas. The Nigerian water policy has indicated that water should be regarded as an economic good as well as social services and encourages the Autonomy of SWAs (AQUSTAT, FAO, 2010).In his study, Olajuyingble (2011), reports that over the years, improvement in domestic water supply has not been impressive. For example, in 1990, 47% of Nigerians had access to improved water. This percentage increased slightly to 53%in 1990, displaying similar growth rate, only 58% access was recorded in 2008 WHO/UNICEFJMP, 2010).

It also revealed that urban domestic water supply has been on decline since 1990. For example, in 1990, 79% of the urban dwellers had access. This decreased to 77% and 75% in the years 2000 and 2008 respectively (WHO UNICEF. JMP, 2010). Piped water is often equipped to safe water. Since improved sources could still contain some harmful substances (Sullivan, 2003).It is also pathetic to note that piped water among the Nigerians has decreased extensively from 14%in 1<)90 to 6% in 2008 (WHO UNICEF,

2010). In their study of factors influencing willingness to pay for improved water supply services in Ibadan metropolis, Oyo state Nigeria. Omonona BT and Fijimi F.O (2011) found that access to safe water supply has been one of the top priorities in developing countries over the past three or four decades and billion of dollars have been invested in pursuit of the goal of 'Universal service' (Suniula, 2005) Shortcomings in the water supply service in large areas of developing countries are critical problem affecting millions of people (WHO, 2000) New Delhi declaration 1990; Dubin 1992; UNICEF, 2004).

Most population growth is taking part in the developing world (UN, 1995). According to National Millennium Development Goals report (2005), access to improved water is a daily challenge for most Nigerians where only 60% of the population has access to improved water and less 50% of rural household have access to good portable water. The present challenges of urban water supply are driven by rapid population growth, urbanization, budgetary constraint etc, while existing water supply project suffer from poor funding or neglect in terms of operations and maintenance which led to epileptic services and resulting in new water supplies being sourced (New York Science Journal, 2011). Ibandan city is among early beneficiary cites in which public water supply started in Nigeria, through Eleyele and Asejire water stations respectively and charge N 1OOOper flat. Monthly for water supply services are critically in short supply.

In developing countries where the development of water is mostly government driven, failure to develop efficient water supply systems has been established as a product of the interplay of several factors. Among the factors is securing finance to build, maintain and expand the system is perhaps the most important (UNEP,2002: Hall, 2006).The availability of finances especially for day to day operations and maintenance is significant in view of the low level of public finances for urban development including water supply (World bank, 1994: Urban Age, 1993).

It is generally observed that water supply in developing countries is undertaken by government Parastatals that have dual objectives of providing a social service while generating revenue to offset cost. Ironically most of these parastatals do not recover their operating expenses from their own revenues, and remain dependent on state governments for subsidies (Hall, 2006).

Studies have also confirmed that about half of the water in drinking water supply systems in the developing world is lost to leakage, illegal hook-ups and vandalism (UN, 2002: Hall, 2006). Lack of institutional objectives, low wage and poor equipment and supplies have also been widely cited as the typical institutional characteristics of water supply agencies in the developing countries (World Bank, 1994: Francys, 1993). One of the Malawi's public water utility providers, the Northern region water Board has US dollar 60 million loss. In its water provision, government authorities have revealed. The authorities attribute the loss to poor management of water resources such as failure to repair broken pipes and leakage of water pipes. The loss is despite government's annual financial allocations to aid the smooth operations of water parastatals, (MWUP, 2011).

2.3 Conceptual Framework
This section discussed the four variables which arc basis of this study. It reviews each variables and its contribution to the provision of water.

2.3.1 Loss of water
Losses through storage can potentially be large, particularly in irrigation areas where up to 40% of storage volume can be lost each year due to evaporation (Graig, 2005).Ghana in West Africa, attempted to solve its difficulties by bringing new, outside managers for its water utility. The hope was that they would operate. It more efficiently and along commercial lines (Green, 2005). The public water utility; Ghana Water Company Limited (GWCL), had previously been able to provide water to half of the country's population of 20 million, But it started losing money for a variety of reasons, including unpaid bills and illegal connections. As a result, it could not make a significant repair or further extend the system.

In 2005, officials in Accra estimated that the company lost half of its daily delivery of 450 million litres through leakages from old pipe (Green, 2005). The government managed to secure a US dollar 10.3 million grant from World Bank, and bilateral donors provided an additional 17 million. The government hoped that the flesh money would enable the GWCL to replace absolute equipment and repair leaking pipes. It also set a goal of installing some 50,000 new household connections and 350 public stand pipes by 2011 in Ghana's main towns (NCEA, 2005).The irony is that six years later, many customers are looking at dry pipes. GWCL officials blame Ghana's energy crisis, the result of how water levels in the reservoir of the Akosombo hydroelectric dam while AVRL's manager emphasize investment problems. The reservoir also gradually loses storage capacity due to sedimentary activity.

Authorities in Malawi attribute the loss of water to poor management of water resources such as failure to repair broken pipes and leaks. This loss is despite government's annual financial allocations to aid the smooth operations (MWUP, 2011). Almost every water system has a problem with water loss, when water is under pressure in kilometers of buried pipes, one would be sure that water will be lost somewhere. Water loss is unmetered water that leaves a water system. In some cases water only seems to be missing because of human errors or other errors such as broken meters. Genuine water loss is generally caused by three things i.e. authorized unmetered accounts, theft, and Leaks (Black, 1989).

One of the reasons that curtail effort to reduce excessive un-accounted for water in developing countries has been lack of motivation at the operations level and particularly lack of resources. Most local authorities in developing countries suffer from shortage of employees with necessary skills who can be engaged in various activities such as looking for sources of leaks. It is anticipated that commercialization will improve and reduce levels of un-accounted for water by injecting managerial efficiency (Phillip, 1987).Commercialization has also been associated with the potential to attract commercial sources of finance necessary for investment, innovation and new technologies (Farma, 2008).

The best way to address the problem of water loss through leaks is doing leak detection survey; this is a step by step way of locating a leak by collecting data of the area system. It would also help to keep records of previously repaired leaks and the location of customer complaints. All pipes should be identified according to type, size and depth and the exact distance from a reference point. The information on valves and hydrants area can be kept on separate maps (Jeffs, 1989).To minimize future human water shortages and undesirable environmental impacts there should be, more equitable sharing of water between society and nature current valuation systems should not only be dominated by economic **values.**

2.3.2 Efficiency in Revenue Collection

There are many issues to be considered in any quantification of the returns arising from use of water, and these must not be identified using only economic criteria. When decisions are made about how water is managed, economic and political consideration are often given priority (Sullvian, 2002).This can be well illustrated by an example, in that where water is provided for both industry and Agriculture, the justification for associated expenditure is provided by an examination of the economic returns on capital invested. However, when assessing domestic water provision, a problem is encountered in defining appropriate measures of returns on investment. Although monetary measures are appropriate for any criteria, certain important attributes of the value of domestic water cannot be measured in this way (Sullvian, 2002).

Water is increasingly perceived as a strategic resource and water accounts have now started to be constructed that stress the economic importance of water. The value of water varies considerably from place to place and also from use to use. Given a quantity of water the value derived from its use in navigation may be much less that from its use in a textile industry. In applying the principle of cost recovery or a degree of financial autonomy in a scheme, two important points need consideration. First is the guarantee of reliability of the supply system for users to accept the principle, the second, and the ability to adjust charges to meet cost of supply (IDRC, 2004).

A 2006 study by African Population and Health Research Center (APHRC), based in the Kenyan capital, Nairobi, showed that water in Korogocho and Viwandani settlements can be far more expensive than water elsewhere in the city. Paying 30 cents for water a day when suppliers are scarce is not feasible for many in Kenya. The latest figures in 2007/2008, Human development report used by the United nations, put the proportion of those living on less than a dollar, a day at almost 23% change is also slowly coming to Kenya's slum as concerns water provision (AMRF, 2007).

In most developing countries water supply is undertaken by government parastatals that have dual objectives of providing a social service while generating revenue to offset cost. Ironically, most of these parastatals do not recover their operating expenses from their own revenues, and remain dependent on state government for subsidies (Hall, 2006). The financial portfolio of supply agencies is further worsened by the low proportion of water users that pay for water (UN, 2002; Hall, 2006).

A good example is drawn from Lagos, Nigeria where only 4% of water users paid their bills (Hall, 2006).The greatest obstacle confronting sustainable water services has been the token attempt by consumers to pay for water supplied. According to argument by Kalbermatten (1999); sources of revenue are to ensure service even to the absolute poor and ensure facility maintenance and expansion. **As** a part of the push to promote private participation in the water sector in Africa and other developing regions, 'Cost recovery' became an increasingly common practice. For the private companies themselves, the application of higher water tariffs and user fees **is** central in turning a profit; but to public utilities as well, increasing tariff is also seen as away to stem financial losses or increase resources for further investment. South Africa **(SA)** has achieved remarkable progress in expanding access to clean water. The constitution of SA proclaims access to water as a basic human right. By 2004 about 88 per cent of the population had access to clean water (UNDP, 2006).

As a matter of Policy, all those with access to piped water are entitled to receive 25 litres per day at no charge. But beyond this threshold, users must pay at steeply graduated rate

Both private companies and local public utilities have strictly enforced the cost recovery practice, affecting poor households most severely. According to UNDP's Human development report, the challenge for all providers, public and private is to extend access and overcome the price disadvantage faced by the poor households. (UN; 2011).Access to clean water can have diplomatic health inputs, l or instance, it is expected that when clean water is available the risk of early death is reduced by 23 per cent in Uganda and 30 per cent in Cameroon (UNDP, 2006).

To ensure cost- effectiveness and operating efficiency and a boost to revenue collection commercialization of water supply is the way to go. Corporate performance is guided and displaced by strategy to achieve financial self-efficiency, quality standards and cost effectiveness in service delivery. In water provision, commercialization involves full application of commercial principles to the water service providers focused on explicit performance objectives, well defined budgets based on revenue from users and managerial and financial autonomy. They therefore can be held accountable for their performance (Akumu, 2004).

In Kenya, the government adopted commercialization through formation of autonomous and competent service water providers under which local authorities still maintain leverage and control (Kenya republic, 1998; Onjala, 2002). Through the sessional paper no 10 of 1996 on Economic Management of renewed growth, the provision of water was decentralized to the operations of local authorities which had necessary administrative and technical capacity (Kenya Republic, 1998).The local authorities through the ministry of local government were urged to revise the pricing of utilities and services to ensure that they reflect the real cost of operations, maintenance and long term capital investment (Onjala, 2005).The state in this case was expected to play a diminishing role in the direct provision of services and insisted act indirectly by providing an enabling environment for private an enabling environment for private sector participation. The government then adopted policies in this effect where privatization has been proposed as the most preferred option in addressing the institutional ineffectiveness and low productivity that has characterized the municipal water supply (Asingo, 2005).

Collection efficiency seeks to examine the percentage of revenue collected based on water that reaches the consumer. A number of factors affect the level of revenue collected. Such factors are consumer records and inefficient billing. The average age of a water bill is a measure of collection efficiency. The attainment of efficiency in any undertaking is, to a great extent, dependent upon a careful study of local conditions and assimilation of vast amount of detail which has to be co-ordinate along certain definite functional lines. This is especially true when applied to the provision of water, and, when it is further realized that furnishing a supply of water provides by far the largest source of revenue in most cities and urban areas (Clowes, 201 1).

2.3.3 Increase Demand for Water

Water is, in theory, a quintessentially, renewable resource it covers most of the world it falls unbidden from the skies. Yet because of human carelessness and profligacy with which water resources have been used, the speed of human population growth and the increasing demands for water, the provision of adequate safe supplies of water is now a major source of concern, expense and even international tension. According to Stolton (2004), it is not generally because water supplies are insufficient. Rather, the crisis due to inability to organize supply properly to meet demand. In many parts of the world environmental mismanagement has led to a critical shortage of flesh water (Dudloy, 2004).

Water plays a great role in social economic development of human population and also for human survival and economic development. Access to safe water supply has been one of top priorities in developing countries over the past three or four decades (Sumula, 2005). According to Drakakis Smith (2000) the enormous volume of water and extensive infrastructure required to fulfill urban water demand have frequently exceeded the ability of government to provide secure supplies, and have also created severe environmental problems. According to the United Nations (2003), the world is facing serious water crisis. The water access and service delivery in the developing world need to be improved drastically and urgently, especially if gains have to be realized in fight against poverty, hunger and disease.

Gihuki (2005), in his study on High spatial and temporal variability of water resources, found out that rainfall and water availability in river basins can vary, creating areas and periods of extreme shortage and excess and therefore, a need for water storage and /or conveyance works to match with demand Different quantities and qualities need to be available at different locations and times. As demand increases and supply is reduced through drought, over use or pollution competition for water increases- competition can lead to conflicts, which cause adverse environmental social and economic impacts.

According to Bosch (2006), bout 1.3 billion people of the third world have no access to adequate safe water. Approximately 2.2 million people in developing countries die each year due to diseases associated with lack of access to clean water (WSSCC, 2010). According to water Aid, a non profit organization headquartered in London, 20 litres of water is the minimum amount required daily for a person's basic needs.
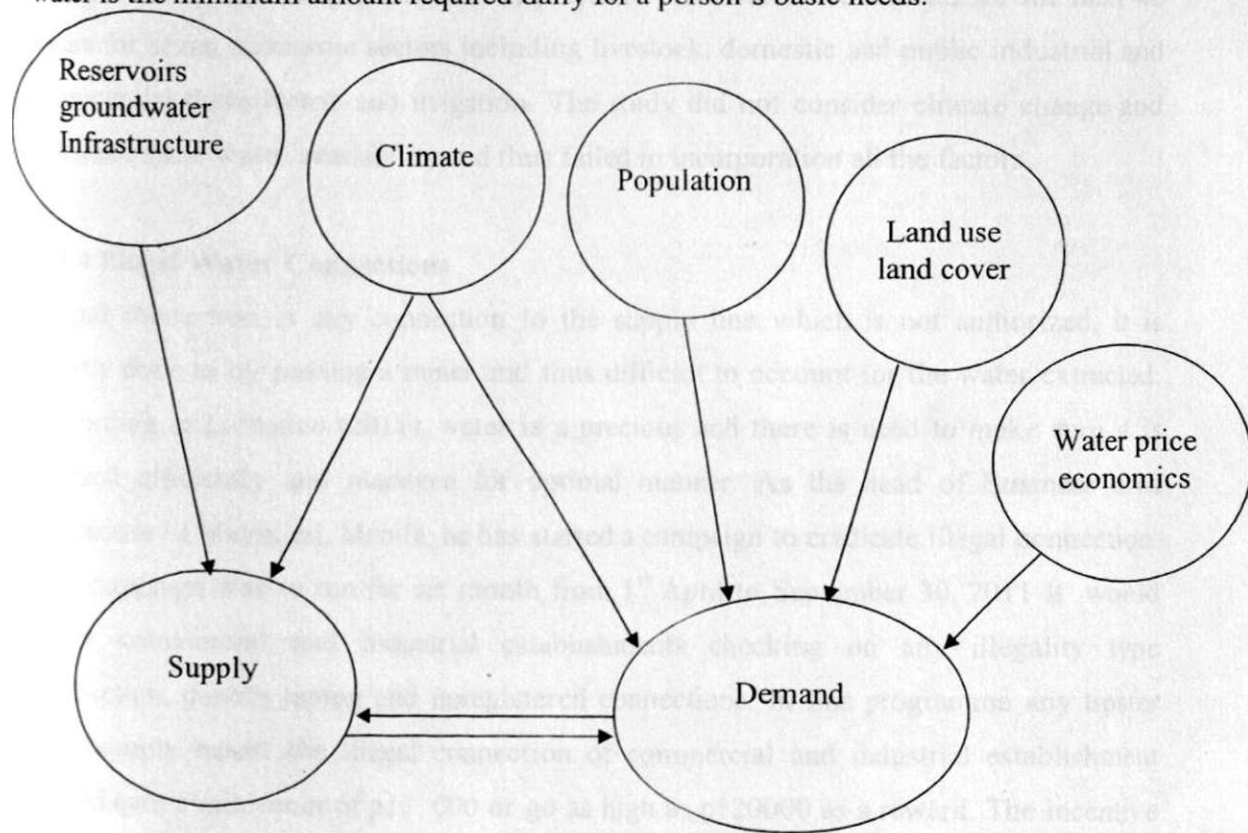
Figure 1: Factors affecting water supply, demand and their relations (NSTC, 2004)

The National science and technology Council (NSTC) on water availability and quality subcommittee of the US (2004) expressed an urgent need to precisely quantify current and future human water demands (WD) and water supply at multiple scales. National scales dialogs organized by the American Water Resources Association (AWRA, 2005) on water resource policy concluded that an integrated assessment of water resources and information sharing was an important step towards preventing future water crises. Climate change may affect many aspects of natural ecosystems, as well as economy, for example, the water withdrawal for irrigation is expected to increase as precipitation decreases and evapotraspiration increases with air temperature (Peterson and Keller, 1990: Doll, 2002).Few studies have addressed the combined interaction of water supply and demand and thus few studies are available to examine the impacts of multiple stresses on water resources at Global level. According to a historic US geological survey (USGS) water use data, Brown (2000) projected freshwater withdrawals for the next 40 years for seven economic sectors including livestock, domestic and public industrial and commercial thermlectric and irrigation. The study did not consider climate change and assumed static water availability and thus failed in incorporation all the factors.

2.3.4 Illegal Water Connections

Illegal connection is any connection to the supply line which is not authorized, it is mostly done to by passing a meter and thus difficult to account for the water extracted. According to Lichanco (2011), water is a precious and there is need to make sure it is utilized efficiently and managed for optimal manner. As the head of Business area operations of Maynilad, Manila, he has started a campaign to eradicate illegal connection. The campaign was to run for six month from 1^M April to September 30, 201 1 It would cover commercial and industrial establishments checking on any illegality type connection, double taping and unregistered connections. In this programme any tipster who simply report the illegal connection of commercial and industrial establishment would earn a minimum of pi 5, 000 or go as high as pi20000 as a reward. The incentive is determined by how big is the under-collection charge of the reported illegal connection. This demonstrated the seriousness of the effects of illegal connections.

According to Hall (2006) and UN (2002) half of the water in the drinking water supply system in developing water supply system in developing world is lost to leakage, illegal hook up and vandalism. It is also noted that water in the informal sector it is sold by cartels and slum dwellers themselves through illegal connections to pipes in the settlements (WA, 2010).

2.3.5 Summary

The literature reviewed in this study clearly explain that water provision is a global issue which needs proper planning and utilization of resources. In most of the developing countries the provision of water was initially carried out by governments, parastatals and local authorities. In recent years the role of water provision has changed from that of offering a social good to economic good. This has been done through commercialization and privatization. This chapter also looked at each of the four independent variables and how it contributes to the provision of water.

| oss of water
storage
nd
onveyance | Total leaks
No of complaints
Vol of water produced
vs water sold
Length of pipe replaced | | | |

Extraneous variable

Climate change

Provision of water

Workers motivation

Areas politics
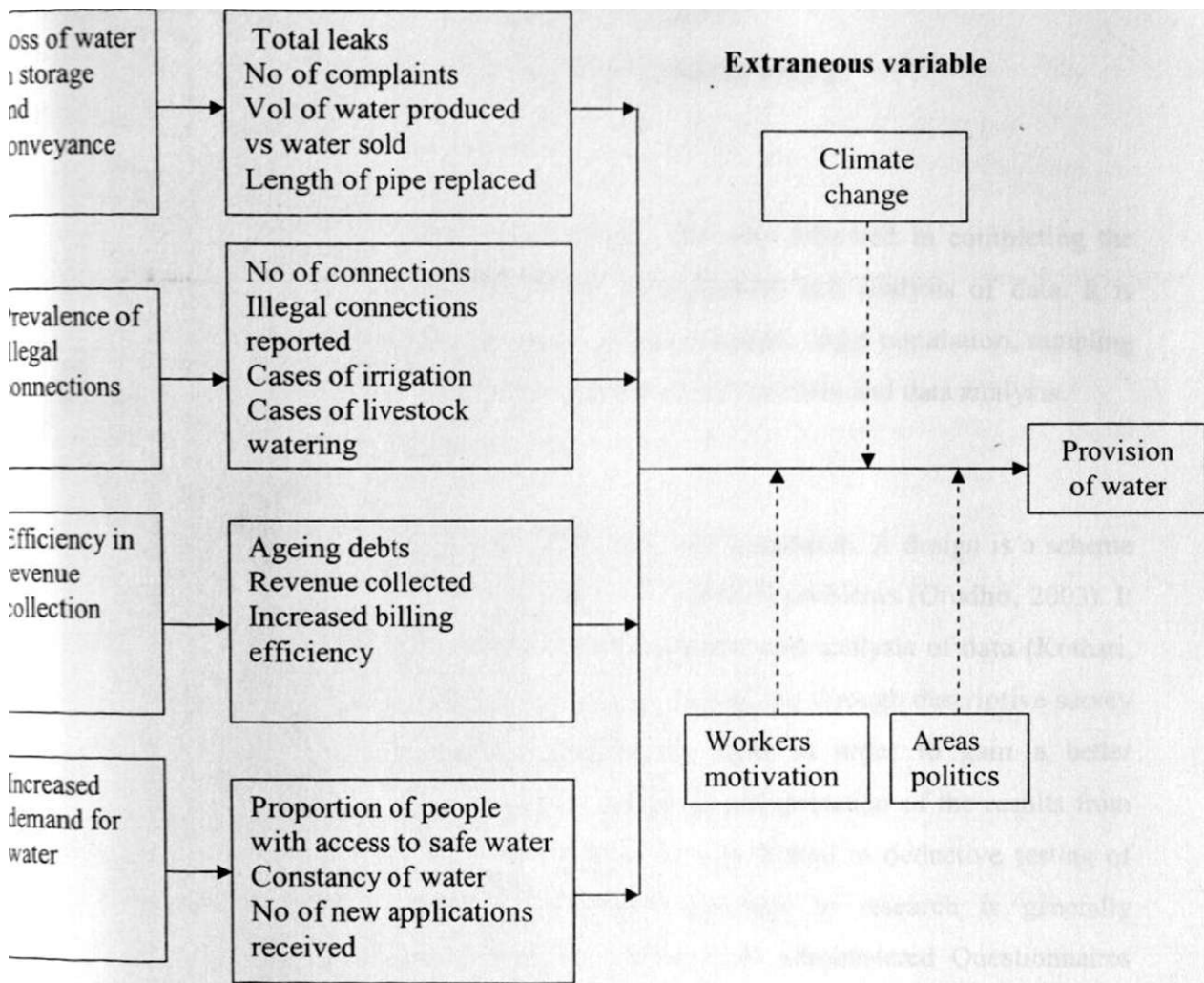
| Independent
variables | **Indicators** | **Intervening
variables** | **Moderating
variables** | **Dependent
variables** |

Figure 2: Conceptual framework

CHAPTER TIIREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter outlines the research methodology that was followed in completing the study. It involves the method of collection, measurement and analysis of data. It is organized under the following sub sections: research design, target population, sampling design, methods of data collection, operationalization of variables and data analysis.

3.2 Research design

Research design refers to the method used to carry out a research. A design is a scheme outline or plan that is used to generate answers to research problems (Orodho, 2003). It constitutes the blue print for the collection measurement and analysis of data (Kothari, 2003). The main focus of this study is quantitative carried out through descriptive survey design. However, some qualitative approach was used in order to gain a better understanding and enable a better and more insightful interpretation of the results from the qualitative data. A quantitative approach is strongly linked to deductive testing of theory through hypothesis, while a qualitative approach to research is generally concerned with inductive testing (Saunders, 2003). Self administered Questionnaires were the main data collection tool accompanied by desk search of documents from NAWASCO. Studies from other related areas were also done to supplement the research correlation of the dependant variables using various statistical measures.

3.3 Target population

 The target population is a well defined set of people, services, elements, events, groups of things or households that are being investigated (Ngechu, 2004) .The target population is also defined as the population to which a study wants to generalize the results (Mugenda and Mugenda, 2003).The target population in this study refers to the 5085 connections which are currently serving 60290 consumers within Nanyuki Municipality. The target population is sought to study the factors affecting the provision of water by NAWASCO.

3.4 Sampling procedure

The sampling plan describes how the sampling unit is selected, sample frame, sampling procedure and sample size. The sampling frame describes the list of all population units from which the sample are selected (Cooper and Schindler, 2003) Stratified random sampling technique was used to select the sample The technique produces estimates of overall population parameters with great precision and ensures a representative sample is derived (Kerry and Bland, 1998). The study grouped connections in three strata, the low density, medium density and high density estates. A purposive selection of an estate from each of strata was done to capture certain categories such as owner occupiers, rental individual connections and rental common user connections. Systematic random sampling was used to select the respondents. Random sampling frequently minimizes the sampling error in the population and increase precision of any estimation method used (Cooper and Shcindeler, 2003).

Table 3.1: Estate and Corresponding Connections

The table below presents the estates within Nanyuki Municipality and their corresponding number of connections.

Population Density	Estate	No of water connections
	Majengo,	392
High	Likii A	381
	Ichuga	354
	Thingithu phase 2	463
	Cottage	429
	Thingithu phase 3	411
	Thigithu phase 1	311
	LikuB	295
Medium	Asian Quarter	421
	Blue gum	304
	Stadium	300
	Muthaiga,	338
Low	Mountain view	250
	Mugambi	245
	National Housing	241

In the high density estates Majengo was selected as it was found to have both the owner occupiers and tenants, population concentrated at small area near town center. In the category of medium density, Thigithu phase 1 was selected as most of the residents have individual water connections. In the low density areas Muthaiga was selected as it was more representative as it includes owner occupiers and tenants with individual connections.

Using proportional of minimum formulae

$n = p \times q \, (z/e)^2$

Where

n=minimum sample size

p=proportion belonging to specified categories

q = proportion not belonging to specified categories

z =value corresponding to the level of the confidence e.g. 95% confidence interval

e%=margin of error required

For a sample of 10000 and below, it required adjustment using 384 as baseline then the following formulae was used to select respondents from each stratum.

1   N

Where n = sample proportional

N= population size, then

$$\frac{384}{1} + (\frac{384}{5085}) = 384 + 0.0755 = 384$$

$$\frac{32}{100} * 384 \qquad\qquad = 123$$

Low density $\frac{20}{100} X\backslash23 \qquad = 25$

Medium $\frac{\quad}{100} * 123 \qquad = 43$

High density $\frac{\quad}{100} X\backslash23 \qquad = 55$

Table 3.2: Sampling Frame

Level	Connections	Percentage %	Sample%
Low density	1074	21	20
Medium	**1631**	32	35
High	2430	47	45
	5085	100	100

Table 3.3: Sampling procedure

Level	Connections	Percentage %	Sample
Low density Muthaiga	25	20	25
Medium density Thigithu	43	35	43
High density Majengo	55	45	55
Total	123	100	123

3.5 Data collection instrument

The study used both primary and secondary data. A self administered questionnaire is the only way to elicit self report on people's opinion, attitudes, beliefs and values (Sproul, 1998).Primary data was obtained through self-administered questionnaires with both open ended and closed questions. Open ended questions allowed the responses from respondents without providing or suggesting the structure of replies. The closed questions enabled the study to collect quantitative data while the open ended collected qualitative data.

The questionnaire was divided into two sections. Section A was concerned with general information about respondent, while section B dealt with issues of determinants of provision of water in Nanyuki. The method of administering the questionnaire was drop and pick aftere respondents were presented with a series of statements and asked to

indicate their degree of agreement or disagreement (Likert scale). A 5 point Likert scale appeared as follows:

l=strongly disagree, 2= disagree, 3=neutral, 4 =agree, 5 =strongly agree

Secondary data was collected by use of desk search approach techniques from published reports and other documents.

3.5.1 Validity

Validity concerns the extent to which a measurement actually measures those feature the investigator wishes to measure, and provided information that is relevant to the question being asked. The measurements are accurate if they are relatively free from systematic errors. The researcher ensured validity by making sure the sampling techniques was free from bias by giving each subject an equal opportunity to score. Validity was also improved through operationalization of variables. The questionnaires were comprehensive to cover all the variables being measured. The study compared conceptual frame work (own variables) with documented theories and studies for validation.

3.6.2 Reliability

Reliability concerns the extent to which measurement is repeatable and consistent. That is free from random errors, Reliable measures, sometimes referred to as good measures, are those which measure a variable precisely and consistently (Baker, 1992). Reliability is said to be stable if it gives consistent results with repeated measurements of the same object with the same instruments. The degree of stability is determined by comparing the result of repeated measurements. The study used the test-retest method which involved administering the same questionnaire twice to the same group at an interval of one week. This was expected to test the reliability of the questionnaire as the main data collection instrument. Using the Spearman's product coefficient on 10% of 123 respondents the reliability was 0.87.A coefficient of 0.80 or more implies that there is high degree of reliability of the data (Mugenda and Mugenda,2003)

Table .1.4: Openitionalization of Variables

Objective/research questions	Variables	Indicator	Level of measurement	Research design	Data collection method	Data analysis
To what extent does loss of water through storage and conveyance affect provision of water	**Independent** -Loss of water in storage and conveyance	-Total leaks and burst reported -No complaints of lack of water -Vol of water produced VS water sold -Length of pipes replaced or rehabilitated	Ordinal	Quantitative	-Survey -Document review	-Descriptive -Content analysis
	Dependant:— provision of water	-Vol of water supplied -Expansion carried out -Cost reduction -Increased quality of service.	Ordinal interval	Qualitative	-Survey -Document review	Content analysis -Descriptive
To what extent docs the preference of illegal water connection affect provision of water?	**Independent:** illegal water connection /use	-No of connections and reconnections. -Illegal connections reported/identified. No. cases of irrigation. No. cases of livestock farming.	Ordinal Interval	Qualitative	-Document review -Survey	Content analysis -Descriptive
	Dependant: -- Provision of water	-Volume of water produced -Reduced revenue	Ordinal interval	Quantitative	-Document review	Content analysis
How does the efficiency in collection of revenue affect provision of water?	**Independent:** inefficiency in revenue collection	-Ageing debts -Revenue collected -No of complaint in billing -Increased billing inefficiency	Ordinal Interval	Quantitative	-Document review -Survey	Content analysis -Descriptive
	Dependent: provision of water	-Deviations from target -Reduction in debt -Increased revenue	Ordinal Interval	Quantitative	-Document review -Survey	Content analysis -Descriptive
How does increase in demand affect provision of water by NAWASCO	**Independent:** Increase in demand for water	-Proportion of people with access to safe water -Constancy of water supply -No .of new applications received	Ordinal Interval	Quantitative	-Document review	Content analysis -Descriptive

3.6 Data Analysis

The completed questionnaires were edited for completeness and consistency. The data was coded to enable the responses to be grouped into various categories. A descriptive analysis was employed. Descriptive statistics such as mean, standard deviation and frequency distribution were used to analyze the data. All quantitative data on factors affecting the provision of water were measured in real values by normalizing. Quantitative data was analyzed using the Statistical Package for Social Science (SPSS). Multiple Regression Analysis used for comparison of variables. Tables were used as appropriate to present the data collected for ease of understanding and analysis. The use of percentages was important for two reasons first they simplify data by reducing all the numbers to range between 0 and 100. Secondly, they translate the data into standard form with a base of 100 for relative comparisons (Cooper and Schindler, 2003).

The study was interested in measuring the factors affecting provision of water 8, (independent variables) and dependent variable Y (provision of water)

The regression equations

$Y = 6_0 + B_i X_1 + 13_2 X_2 + B_3 X_3 + B_4 X_4 + oo$

Where Y is dependent variable (provision of water). B_0 is the regression coefficient, B_1 B_2 B_3 B_4 are slopes of regression equation. X_1 is the losses in storage and conveyance independent variable,

X_2 - prevalence of illegal connection independent variable

X_3 - revenue collection inefficiency independent variable

X_s - Increase in demand for water independent variable

oo - is an error term normally.

3.7 Summary

Chapter three mainly dealt with research methodology. The main focus of this study is quantitative and the main data collection tool was self administered questionnaire. The target population being 5085 connections within residential estates. The residential estates were grouped in three strata which were based on population density. Purposive selection of an estate was done from each strata this was to cover such factors as owner occupation, rental individual connections and rental common user connections. Systematic random sampling technique was used to select respondents. Quantitative data was analyzed through Statistical Package for Social Science (SPSS). Descriptive analysis was used for qualitative data. Multiple regression models were employed to summarize and facilitate comparison of variables and their level of contribution to provision of water.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.1 Introduction

The purpose of this chapter was to present, analyze and interpret the data in order to answer the research questions. The data was collected through questionnaire as the main data collection instrument, secondary data was used to collaborate the views of the respondent. To enhance quality of data obtained, likert type questions were included whereby respondents indicated the extent to which the variables were practiced in a five point likerts scale. The purpose of data analysis was to determine to what extent the presupposed factors do affect provision of water based on the views of the respondents.

4.2 Response Rate

The study targeted 123 respondents, 110 respondents filled-in and returned the questionnaires making a response rate of 89%. This was a commendable response rate which was made a reality by researcher's effort to visit the respondents.

Table 4.1: Response Rate

Response	Frequency	Percentage
Responded	110	89
Not responded	13	11
TOTAL	**123**	**100**

Table 4.2: Gender of Respondents

GENDER	FREQUENCY	PERCENTAGE
Male	**41**	37.3
Female	69	67.7
Total	**110**	**100**

From the findings 67.7% of the respondent of this study were female while 37.3% were male this imply that composition guarantee the study wide response across the gender divide.

4.2.1 Age of the Respondents

The study requested the respondents to indicate their age brackets.

Table 4.3: Age Bracket

Age	Frequency	Percentage %
18-35 years	32	29.1
36-50 years	60	54.5
Above 51 years	18	16.4
Total	**110**	**100**

Table 4.3 shows that majority (54.5%) of the respondents were 36-50 years, 29.1% of the respondents were between 18-35 years of age, while 16.4 % were above 51 years..

Table 4.4: **Length of Time Residence in Nanyuki**

Residence duration	Frequency	Percentage %
Less than 3yrs	16	14.5
3-5 years	15	13.6
6-10 years	29	26.4
Above lOyears	50	45.5
	110	**100**

Table 4.4 shows that majority (45.5%) of the respondents indicated that they had been residents of Nanyuki for more than 10 years , 26.4% between 6-10 yrs ,13.6%-3-5yrs while14.5% were residents for less than 3 years.

Table 4.5: Highest Level of Education

Level of education	Frequency	Percentage
No educational primary level	5	4.5
Pnmary	7	6.4
Secondary	11	10.0
Diploma	28	25.5
Certificate	33	30.0
Bachelor	16	14.5
Masters	8	7.3
Phd	2	1.8
Total	**110**	**100**

According to the findings majority of respondents had a certificate as shown by 30.0%, 25.5% had Diploma, 14.5% had first degree, 10% secondary levels, 7.3% had masters and 6.4% were primary school leavers, 4.5% had Nil education while 1.8% had a PhD.

4.3 Factors Affecting Provision of Water

The study sought to find out if loss of water through storage and conveyance affect provision of water by NAWASCO.

4.3.1 Loss of Water through Storage and Conveyance

The study asked the respondents whether loss of water through storage and conveyance affected provision of water by NAWASCO.

Table 4.6: I.oss of Water through Storage and Conveyance

Response	Frequency	Percentage %
Yes	81	*73.6*
No	29	26.4
Total	n o	100

Majority of the respondent (73.6%) indicated that loss of water through storage and conveyance affect provision of water by NAWASCO, 26.4% indicated that loss of water does not affect provision of water.

Table 4.7: Extent to which loss of water affect provision of water by NAWASCO

Response	Frequency	Percentage
Very great Extent	17	21.0
Great Extent	45	56.6
Medium	15	18.5
Low	4	4.9
Total	81	100.0

According to the table 4.7, majority (56.6%) indicated that loss of water affect provision of water to great extent, 21.0% to a very great extent, 18.5% to medium extent and 4.9% to low extent.

The study also sought to evaluate how well or poorly the respondents believed NAWASCO performed on various indicators. A scale of 1 to 5 was provided where: 1 =worst, 2= worse, 3=Neutral, 4= better, 5= much better

Table 4.8: Indicators of Loss of Water

Indicators	Mean	Std Dev
Reaction to leaks **and** burst reported	3.28	0.96
Complaint of lack of water	2.25	1.03
Replacement of old pipes	3.5	0.96
Continuous process of improvement	3.87	0.93
Regular line inspection	3.28	0.88

Majority of the respondent indicated that NAWASCO performed better in continuous process of improvement as indicated by a mean score of 3.87, neutrally to reaction to leaks and bursts as indicated by a mean score of 3.28, neutrally to replacement of old pipes as indicated by mean score of 3.5, neutrally to regular line inspection mean score of 3.28 and worse in reaction to complaint of water as indicated by a mean score 2.25 .

4.3.2 Illegal Water Connection

The second objective of the study was determined how prevalence of illegal water connection affects provision of water by Nanyuki water and sewerage company (NAWASCO).

Table 4.9: Illegal water connections

Response	Frequency	Percentage %
Yes	84	76.4
No	26	23.6
Total	**no**	100

According to table 4.9 majority of respondents (76.4%) indicated that illegal water connection affect provision of water by NAWASCO while 23.6% of the respondent indicated that illegal water connection do not affect the provision of water.

Table 4.10: Extent to which illegal water connection affect provision of water by NAWASCO

Response	Frequency	Percentage
Very great Extent	14	16.7%
Great extent	36	42.9%
Medium extent	30	35.7%
Low external	4	4.8%
Total	**84**	**100**

On determination to which extent illegal connection affect provision of water majority of respondents (42.9%) indicated it affects to great extent, 35.5% to a medium extent 16.7% to a very great Extent, 4.8% to a low extent.

Table 4.11: Agreement that Illegal Water Connection Affect Provision of Water

Indicators	Mean	Std dev
Irrigation of plants affects provision of water by NAWASCO	3.85	1.33
Watering of livestock affect provision of water by NAWASCO	3.39	0.84
Illegal connections affect provision of water .Illegal connection are always disconnected after detection	4.1	0.85
Customer with illegal connections always re-connected after disconnection.	3.38	0.93

The respondents indicated neutrality that customers with illegal water connections always reconnect after disconnection as indicated by a mean score of 3.38, the respondents also neutrally indicated that watering of livestock affect provision water as indicated by a mean score of 3.39. The respondent agreed that irrigation of plants affect provision of water as shown by a mean score of 3.95. The respondent strongly agreed that illegal connection affect provision of water as shown by mean score of 4.1.

4.3.3 Efficiency in revenue collection

The third specific objective was to establish how revenue collection efficiency affects provision of water by NAWASCO.

Table 4.12: Efficiency in revenue collection

Response	Frequency	Percentage%
Yes	75	68.2
No	35	31.8
Total	**110**	**100**

As shown from the table 4.12 majority of respondents (68.2%) indicated that efficiency in revenue collection affect provision of water by NAWASCO while 31.8% indicated that efficiency in revenue collection do not affect provision of water.

Table 4.13: Extent to which efficiency in revenue collection affect provision of water by NAWASCO

Response	Frequency	Percentage%
Very great extent	10	13.3
Great extent	21	28.0
Medium extent	36	48.0
Low extent	8	10.7
TOTAL	**75**	**100**

From the table, 48% the respondents indicated that efficiency in revenue collection affect provision of water by NAWASCO to a medium extent, 28% of the respondent to a great extent , 13.3% to a very great extent, 10.7% indicated that efficiency in revenue collection affected provision of water to a low extent.

Table 4.14: Agreement that the efficiency in revenue collection affect provision of water.

Indicators	Mean score	s.d
1. Aged debt can affect provision of water	4.1	1.4
2. Bills timely dispatched	3.6	1.5
3. Bills always reflect the correct state of affairs	3.9	1.39
4. Complaints about inaccurate bills collected soonest possible	3.80	1.41
5. Efficiency in revenue collection improves services	3.9	1.4
6. Customers clear their bills within reasonable time after receiving them	3.63	1.23
7. Water still affordable even after commercialization	3.7	1.42

From table 4.14 there was agreement that bills always reflect the correct state of affairs as shown by a mean score of 3.9, inaccurate bills are corrected as soon as possible as shown by a mean score of 3.8, customers clear their bills within reasonable time as shown by mean of 3.63, agreement that debt affect provision of water as shown by mean of 4.1.

4.3.4 Increase in demand for water

The fourth objective was to determine how increase in demand for water effect provision of water by NAWASCO. The study asked the respondent if they thought increased demand for water affected provision of water by NAWASCO.

Table 4.15: Increased demand for water.

Response	Frequency	Percentage%
Yes	89	80.9
No	21	19.1
Total	**110**	**100**

Table 4.15 indicates that out of 110 respondents majority of respondents (80.9%) felt that increase in demand for water affected provision of water by NAWASCO.

Table 4.16: Extent to which increased demand for water affects provision of water.

Response	Frequency	Percentage%
Very great extent	54	60.7
Great extent	27	30.3
Medium extent	7	7.9
Low extent	1	1.1
Total	**89**	100

Out of the 89 respondents who indicated that increased demand for water effect provision of water 60.7% indicated that increased demand for water effect provision for water to a very great extent, 30.3% to a great extent, 7.9% to medium extent and 1.1% to a low extent.

The study also thought to evaluate how well or poorly the respondent believed MAWASCO performed on various indicators. A scale of 1 to5 was provided where l=not all. 2= low extent, 3=moderate extent, 4=great extent 5=very great extent.

Table 4.17: Indicators related to increased demand for water

Indicators	Mean	Std dev
Increase in population have affected provision of water by NAWASCO	4.2	1.00
Use of water for other purpose other than domestic use affect provision of water. Supply of water to areas outside.	4.0	1.04
Supply of water to areas outside Nanyuki municipality affect provision for water.	3.74	1.17
There has been improved services since NAWASCO took over water services from Nanyuki municipal council.	4.1	1.04
Water supplied by **NAWASCO** is fit for domestic use	4.4	1.00

There was a strong believe that water supplied by NAWASCO was fit for human consumption as shown by a mean of 4.4, Increase in population affected provision of

water by NAWASCO to a great extent as shown by a mean of 4.2, use of water for other purposes other than domestic use a affect provision of water to great extent as indicated by a mean of 4.0, there have been improved service as shown by mean score of 4.1, supply of water outside Nanyuki municipality affect provision of water to a great extent as shown by a meant score of 3.74.

4.4 Multiple Regression Analysis

Multiple regression analysis was done to measure the strength of relationship between four studied variables.

Table 4.18: Multiple Regression Analysis

Model	Unsteadied Coefficients		Standardized coefficients			95% confidence Interval for B	
	B	Std	Beta		sig	Lower bound	Upper
constant	2.200	0.469		4.694	0.000	1.271	3.129
loss of water	0.223	0.099	0.159	2.253	0.026	0.027	0.420
Illegal connection	0.669	0.093	0.697	7.207	0.000	0.027	0.420
Revenue collection	0.228	0.110	0.203	2.075	0.040	0.010	0.497
Increased demand for water	0.560	0.077	0.493	7.227	0.000	0.406	0.714

Dependent valuable: provision of quality water

The study conducted a multiple regression analysis so as to determine the relationship between provision of water by NAWASCO and the four variable factors .The equation $(Y=Bo+ B_1X_1+ B_2X_3 + B_4X_4)$ will be $Y=2.200+0.223X_1+0.669X_2 +0.228X_3 +0.560X4$

Where Y is the depend variable (provision of water),X_1 is the loss of water ,X_2 is effect of prevalence of illegal water connections, X3 is the efficiency in revenue collection and X4 is the effects of increased demand for water .

From the regression equation, taking all factors (loss of water, illegal connection, efficiency in revenue collection and increased demand for water) constant at Zero, provision of water will be 2.200. The findings also shows that taking all other independent variable at Zero, a unit increase in loss of water will lead to 0.223 increase in provision of water, unit increase in illegal connection will affect the provision of water by 0.669, a unit increase in efficiency in revenue collection will affect the provision of water by 0.228 while a unit increase in demand for water will affect provision of water by 0.560.

Table 4.19: Coefficient of Multiple Determination (R^2)

MODEL	R	R square	Adjusted R square	Std error of the estimate
1	0.776	0.602	0.587	0.746

Predictors: (constant), loss of water, prevalence of illegal water connection, revenue collection efficiency, increased demand for water

Dependent variables: Provision of quality water.

Coefficient of determination explains the extent to which changes in the dependent variable can be explained by the change in the independent variables or the percentage of the variation in the dependent variable (provision of water) is explained by all the four independent variables (loss of water, illegal connections, revenue collections, increased demand for water).

The four, independent variables that were studied, explains only 60.2% of provisions of water as represented by R~, this therefore means that independent variables contributes about 60.2% while other factors not studied in this study contribute 39.8% to the provision of water.

Table 4.20: Determination of whether the multiple regression models is useful for predicting the response at the 5% significance level

Model		Sum of squares	df	Mean square	F	Sign
1	Regression	88.275	4	22.069	39.669	0.000^a
	Residual	58.416	105	0.556	0.556	
	Total	**146.691**	**109**			

Predictors (constant), loss of water illegal connection, efficiency in revenue collection, increased demand for water.

Dependent variable: provision of quality water services.

At the a=0.05 level of significance , f_4, 105=39.668, p-value=0.000, there exists sufficient evidence to conclude that at least one of the predictors is useful for explaining the problems with provision of quality water services; therefore the model is useful.

CHAPTER FIVE

SUMMARY OF THE FINDINGS, DISCUSSIONS, CONCLUSONS AND RE(OMMEDATIONS

5.1 Introductions

This chapter provides the summary of the findings, discussions, conclusions and also gives recommendations in terms of the specific objectives of the study.

5.2 Summary of the Findings

This section summarizes the findings from chapter four. The summary is as per the specific objectives of the study.

Majority of the respondents 73.6% were of the opinion that loss of water affected provision of water by NAWASCO, 56.6% of those who indicated that loss of water affected provision of water were of the opinion that it affected to a great extent 21.0% to a very great extent, 18.5% to a medium extent   and 4.9% indicated loss of water affected to a low extent. Majority of the respondent indicated that NAWASCO performed better n continuous process of improvement as shown by mean of 3.87, neutrally to reaction to eaks and bursts are indicated by a mean score of 3.28 and neutrally to replacement of old pipes as shown by a mean score of 3.75, neutrally to regular line inspection as shown by mean of 3.5. NAWASCO performed worse in complaint of lack of water as indicated by a mean score of 2.25. From NAWASCO documents the study found out that 35.87% of '.he water produced is recorded as unaccounted for water (UFW). An average of 180 ::ases leaks are reported monthly.

Majority of the respondent (76.4%) were of the opinion that illegal water connection affected provision of water by NAWASCO. Out of those who were in agreement that illegal connections affected provision of water 42.9% indicated that illegal connections affected to a great extent, 33.7% to a medium extent. There was also an agreement that illegal connections affect provision of water as shown by a mean score of 4.1, neutrality •ʳ agreement that customers with illegal connections always reconnected after

disconnection as shown by a mean score of 3.9. The respondents agreed that irrigation of slants affect provision of water as shown by a mean score of 3.85, agreed that illegal connections are also disconnected as shown by mean score of 3.28, neutrality that catering of livestock affect provision of water as shown by mean score of 3.39 agreement that irrigation of plants affect provision of water as shown by mean score of 3.S5. agreed that illegal water connection are disconnected after detection as shown by mean score of 3.95. From NAWASCO'S document the findings were that there is a monthly average of 300 cases of illegal connection that are disconnected or removed and 218 cases of irrigation reported , while cases of un authorized self reconnection after disconnection were indicated as 200 in number.

On the third specific objective of the study, majority of the respondents (68.2%) were of the opinion that efficiency in revenue collection affect provision of water by NAWASCO, 48.0% of those in agreement indicated that it affected to a medium extent while 28.0% indicated it affected to a great extent, 13.3% to a very great extent and 10.7% to a low extent. There was agreement that bills always reflect the correct state of affairs as shown by mean of 3.9, inaccurate bills are corrected soonest possible as ndicated by a mean score of 3.63. There was also agreement that efficiency in revenue collection improves services, agreement that water is still affordable even after commercialization .On looking at NAWASCO'S documents the study found out that ageing, debts was standing at Ksh 36 million while the average monthly revenue was Ksh 30 million, reduction on debt standing .at 80%. The average annual complaints stood at +00 in number.

The fourth specific objectives of the study was to determine how increase in demand for -ater affect provision of water by NAWASCO majority of the respondents (80.9%) were of the opinion that increased demand for water affect provision of water 60.7% of those in agreement indicated it affected to a very great extent, 30.3% to a great extent 7.9% to a medium extent and 1.1% to a low extent. There was agreement that water supplied by NAWASCO is fit for domestic use as shown by a mean score of 4.4, increase in population affect provision of water to a great extent as shown by a mean score of 4.2 ,

->e of water for other purpose other than domestic use affect to a great extent as shown by a mean score of 4.0, services have improve since N A W A S C O took over to great extent as shown by mean score of 4.1 and there was neutrality in agreement that supply of water outside Nanyuki municipality affected provision of water as shown by a mean score of **3.78.** Review of documents from N A W A S C O revealed that demand for water nas increased. The company has extended provision of water to areas outside Nanyuki municipality to areas such as Katheri, Kangata, Nkado and Nturukuma areas totaling 3Skm and sweet-water 12km. The demand for water has increased as evidenced by an average of 2000 new applications annually.

5.3 Discussions

The first objective of the study was to establish how loses in storage and conveyance affect provision of water by N A W A S C O. According to the study, 73.6% of the respondents were of the opinion that loss of water affect provision of water by N A W A S C O. Finding from N A W A S C O records indicate that 35.87% of water produced is recorded as unaccounted for water (UFW), an average of 180cases of leaks are "eported monthly this is in agreement with Hall (2006) that about half of the water in drinking water supply systems in the developing world is lost through leakage, illegal look-up and vandalism. The respondent also indicated neutrality in N A W A S C O replacement of old pipes with a mean score of 3.75 this is also in agreement with Green, 12005) whose findings were that half of Accra's daily delivery of 450 million litres is ost through leakage of old pipes.

^he second specific objective of the study was to determine how prevalence of illegal ^ater connection affects provision of water by N A W A S C O. Majority of the respondents   6 4%) were of the opinion that illegal water connections affect provision of water this is in agreement with UN (2002) whose findings indicate half of water in drinking system as being lost to illegal look-up. ULA (2010) also show water in the informal sector as being sold by cartels and slum dwellers themselves through illegal connections to pipes •n the settlements. On reviewing N A W A S C O'S documents the finding were that there *as a monthly average of 300 cases of illegal connections which are disconnected or

removed and 218 cases of irrigation reported, while cases of unauthorized self reconnection after disconnection were indicated as 200 in number. To show the seriousness of the effect of illegal connections lichano (2011) rolled out a programme in manila where any tipster who simply reported an illegal connection of commercials and industrial establishments would earn a minimum of pi5, 000, or go as high as pi20, 000 as a reward.

The third specific objective of the study was to establish how revenue collection efficiency affects the provision of water by NAWASCO. Majority of the respondents (68, 2%) were of the opinion that efficiency in revenue collection affect provision of water with 48.0% of those who were in agreement indicated that efficiency in revenue collection affected provision of water to a medium extent. The findings are in agreement with those of Clownes (2011) that supply of water provides by far the largest source of revenue in most cities and urban areas. There was also agreement that efficiency in revenues collection improve services this is in agreement with Akumu (2004) that to ensure cost - effectiveness and operating efficiency and boost revenue collection, commercialization of water supply is the way to go.

Review of NAWASCO'S documents the study found out that ageing debt was standing at Ksh 36 million while the average monthly revenue was Ksh 30 million, reduction on debt standing at 80%. The average annual complaints on meter reading stood at 400 in number those finding are in agreement with views of Kulbermatten (1999) which suggests that sources of revenue are to ensure services even to the absolute poor and ensure facility maintenance and expansion. The findings are also in agreement with Sulluvan (2002) that when decisions are made about how water is managed, economic and political considerations are often given priority. Majority of the respondents also agreed that water is still available even after commercialization.

The fourth specific objective of the study was to determine how increased in demand for water affect provision of water by NAWASCO. Majority of the respondents (80.9%) were of the opinion that, increased demand for water affect provision of water , 60.7% of

those of the opinion that increase in demand affect to very great extent and 30.3% to a great extent . The findings also indicate that increase in population affect provision of water to a great extent as shown by a mean score ol 4.2, use of water for other purposes than domestic use affect provision of water to a great extent as shown by a mean score of 4.0 review of documents from NAWASCO revealed that demand for water has increased with evidence of an average of 2000 new application for connection annually. The company has also extended provision of water to areas outside Nanyuki municipality to areas such as Katheri, Kangaita, Nkando and Nturukuma areas totaling 38 km and Sweetwaters 12kms. The findings agree with WSSCC (2010) which puts persons daily basic need standing at a minimum 20 litres of water and that of Sumila (2002) that access to safe water supply has been of top priority in developing countries over the last four decade. The findings from NAWASCO also revealed that constancy of water supply is above average expected during the dry spell from January to April. This is in agreement with Gichuki (2005) in his study on high spatial and temporal variability of water resource , rainfall and water availability in river basin can vary , creating areas and periods of extreme shortage and excess creating need for storage and /conveyance works to match with demand.

5.4 Conclusions
The study concludes that loss of water through storage and conveyance affect provision of water by NAWASCO to a great extent NAWASCO performed better in continuous process of improvement, neutrally to reaction to leaks; neutrally to replacement of old pipe while its performance is worse in reaction to complaints of lack of water. It can also be deduced from the study that quite a percentage of water produced is un accounted for.

The study also concludes that illegal connections affect provision of water by NAWASCO to a great extent. The study also concludes that NAWASCO performed neutrally to disconnection of illegal connections, there was also neutrality to the livestock watering affecting provision of water. Illegal connections are disconnected after detection and irrigation of plants affect provision of water for domestic use.

It is also concluded that efficiency in revenue collection affected provision of water to a medium existent. There are aged bills and NAWASCO has made great effort to recover the debts. NAWASCO also dispatch bills in time and they always reflect the correct state of affairs.

The study also concludes that efficiency in revenue collection improves services and water is still available even after commercialization The study concluded that increased demand for water affect provision of water by NAWASCO to a very great extent. There was also agreement that use of water other than for domestic use affect provision of water to great extent. The provision of water by NAWASCO has also been affected by increase in population while there is neutrality on effect of supplying water to areas outside Nanyuki municipality. It can also be deduced that provision of water services have improved since NAWASCO took ovef- from the Nanyuki Municipal Council.

5.5 Recommendations

The study recommends that for NAWASCO to satisfy its customers it should improve on customers complains to lack of water , do regular line inspection and attend to reported leak and bursts within the shortest practicable time.

On the illegal water connection, the study recommends that NAWASCO improve on field surveillance to detect, disconnect and monitor all re-connections to minimize   loss of water through illegal connections. Further, the company should deal firmly with customers who divert water meant for domestic use to irrigating their farms.

The study also recommends that NAWASCO should improve revenue base by dispatching the bills in time and all money due collected in time. The study further recommends that NAWASCO provides for bills to be paid through other institutions such as banks and other money transfer systems.

The study finally recommends that NAWASCO improves on water abstraction and storage to meet the ever growing demand caused by increase in population. The company should also improve on the infrastructure to reach out to customers who are outside Nanyuki Municipality while maintaining provision to those within the municipality.

The study in particular recommends that the company should focus more on loss of water through storage and conveyance, illegal water connection, efficiency in revenue collection and increased demand for water to ensure provision of water to its customers.

5.6 Recommendations for Further Studies

The study focused on the factors affecting provision of water by NAWASCO and established that loss of water, illegal connections, efficiency in revenue collection and increased demand for water affect provision of water by NAWASCO. In the course of work, I found the following variables need further research.

1. Effects of commercialization on provision for water
2. Influence of source of water on effective provision of water
3. Social economic factors affecting provision of water.

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APPENDICES

Appendix I: Introduction Letter
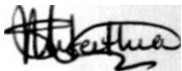
Dear Respondent,

You are kindly requested to participate in a survey that constitute academic research as part of Master of Arts project planning and management of the University of Nairobi (UON).The survey is to investigate the factors affecting provision of water by Nanyuki Water and Sewerage Company (NAWASCO).You have been randomly selected to participate in this research. Your participation is very important to this research if the results are to be accurate. Attached is a brief questionnaire, which should only take about 15 minutes to complete. Your answers will be completely anonymous and confidential. NO personal details will be reported on any project or resulting publications.

I would be extremely grateful if you would spend a few minutes to complete the questionnaire and I would pick it up after 7 days. The research is completely voluntary and returning a completed questionnaire implies consent to participate in the survey.

Your assistance will contribute greatly to the success of my research, each and every response is important and I appreciate your willingness to help. Thank you.

Yours faithfully,

Stephen Muteithia

Reg No.: L50/60526/2010

The information provided in this questionnaire will be treated with confidence and will be used only for academic purposes. Please fill in the questionnaire as accurately as possible.

Either tick in the appropriate box or answer in the space provided.

SECTION A: DEMOGRAPHIC INFORMATION

1. What is your Gender: Male   [   ]   Female   [   ]
2. Which is your age bracket   18-35 years   [   ]
                               36-50 years   [   ]
                               Over 51 years   [   ]

1. For how long have you been a resident of Nanyuki?

Less than 3 years	
3-5 Years	
6- 10 Years	
Over 10 year	

2. What is you highest level of education (Please tick appropriately)

No education [   ]

Primary   [   ]

Secondary   [   ]

Certificate   [   ]

Diploma   [   ]

Bachelors   [   ]

Masters   [   ]

Phd   f   1

SECTION B:

1 a. To what extent do you think that provision of quality water services is influenced by certain factors?

Very great extent	[ ]
Great extent	[ ]
Moderate extent	[ ]
Low extent	[ ]

b. In your own opinion does loss of water affect provision water by NAWASCO?

Yes	[ ]
No	[ ]

c. If your answer is YES to what extent does loss of water affect provision of water?

Very great extent	[ ]
Great extent	[ ]
Moderate extent	[ ]
Low extent	[ ]

Loss of water

J. The following is a set of possible measures/indicators that loss of water affects provision of water. Please evaluate how well or poorly you believe NAWASCO performs on the indicators. Please use the following response scale by ticking your responses.

1= Worst,   2= Worse,   3=Neutral,   4= Better,   5 = Much better

	Worst	Worse	Neutral	Better	Much better
Reaction to leaks ai burst reported					
Complaints of lack water					
Replacement of old pipe					
Continuous process improvement					
Regular line inspection					

ILLEGAL WATER CONNECTION

2a. In your opinion does illegal water connection affect provision of water by NAWASCO?

                   Yes   [   ]   NO [   ]

b. If yes, to what extent does illegal connection affect provision of water?

     Very great extent [   ]   Great extent [   ]   Moderate extent [   ]

     Low extent   [   ]

c. What is your level of agreement with the following statements which relate to effect of illegal connection on provision of water. Using a scale 1-5 where 1 strongly disagree 2 disagree 3 neutral 4 agree 5 strongly agree

	Strongly agree	Agree	Neutral	Disagree	Strongly Disagree
Irrigation of plants affect provision of water by NAWASCO					
Watering of Livestock affect provision of water by NAWASCO					
Illegal connections affect provision of water					
Illegal connections are always disconnected after detection					
Customers with illegal connection always re -connect after disconnection by NAWASCO					

EFFICIENCY IN REVENUE COLLECTION

3a. In your own opinion does efficiency in revenue collection affect provision of water by NAWASCO.

   Yes [ ]   No [ ]

b. If yes to what extent does efficiency affect provision of water?

   Very great extent [ ]

   Great extent

   Moderate extent [ ]

   Low extent   [ ]

c What is your extent of agreement with the following statements that relate to effect of efficiency on provision of water. Use scale of 1-5 where l=strongly disagree 2. Disagree 3. Neutral 4. Agree and 5 strongly agree

	1	2	3	4	5
Aged debts Can affect provision of water					
Bills are timely dispatched					
Bills dispatched always reflect the correct state of affairs					
Complaints about inaccurate bills are corrected soonest possible					
Efficiency in revenue collection improves services					
Customers clear their bills within reasonable time after receiving them.					
Water is still affordable even after commercialization					

Increased demand for water

4a. In your own opinion does increased demand for water affect provision of water by NAWASCO

Yes [ ]   No. [ ]

b. If yes to what extent does the increased demand affect provision of water?

　　　Very great extent　　[　　]　　Great extent　　[　　]　　Moderate extent [　　] 　Low

extent [　　]

c. To what extent do you agree with the following statements that relate to how increased demand affects provision of water by NAWASCO?

	Very great extent	Great extent	Moderate tent	Low extent	Not at all
Increase in population have affected provision water by NAWASCO					
Use of water for other purposes other than domestic use affect provision of water					
Supply of water to areas outside Nanyuki Municipality affect provision of water					
There has been improved services since NAWASCO took over water services from Nanyuki municipal council					
Water supplied by NAWASCO is fit foror domestic use					