IMPROVING SANITATION SYSTEMS: "TECHNICAL AND SOCIO - ECONOMIC PERSPECTIVES"

The case study of Kigali City, Rwanda

Marcelline Kayitesi

Master (Integrated Water Resources Management) Dissertation
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IMPROVING SANITATION SYSTEMS: "TECHNICAL AND SOCIO - ECONOMIC PERSPECTIVES"

A Case study of Kigali City, Rwanda

By

Marcelline Kayitesi

A Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree of Master in Integrated Water Resources Management of the University of Dar es Salaam

University of Dar es Salaam

July, 2008

CERTIFICATION

The undersigned certify that they have read and hereby recommend for the acceptance by the University of Dar es Salaam the dissertation entitled: ***Improving Sanitation Systems: "Technical and Socio-Economic Perspectives", a case study of Kigali City, Rwanda***, in partial fulfillment of the requirements for the degree of Master in Integrated Water Resources Management of the University of Dar es Salaam.

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Prof F.L. Mwanuzi

(Supervisor)

Date……

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Prof Shadrack Mwakalila

(Supervisor)

Date…….

DECLARATION

AND

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I, **Marcelline Kayitesi**, declare that this dissertation is my original work and that it has not been presented, and will not be presented to any other University for a similar or any other degree award.

Signature: …….

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The success can never happen without the wish of Almighty God as well as the support, encouragement and contributions from various individuals and organizations. First and foremost, I thank almighty God to the fullest for his blessings and having provided me with good health and for lighted me with the light of hope every time I found myself in difficult situations. My life here wouldn't have been comfortable without prayers and love from my family and friends.

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DEDICATION

Dedicated to:

My mother Marcianne M. Ruzindana

My late father Athanase Ruzindana and to

My two brothers, Marcel Rutayisire and Maurice Ruzigana

ABSTRACT

Lack of adequate sanitation systems has an impact to human life as well as to the natural environment. Over 80% of the country's population has access to latrines, only 8% of these meet hygienic standards. Thus, sanitation related diseases present the greatest health burden on the individual household and on the country. The aim of this work is to improve sanitation systems in the City of Kigali by analyzing practices with respect to technology, provision and management of sanitation systems. In order to achieve the goals of this study, a combination of literature review, interviews with key informants were performed. A questionnaire based survey was also conducted in 200 households in Nyarugenge district.

The research found that existing institutional framework for sanitation sub sector was incompetent and need capacity building of human resources and proper coordination of all key actors. Lack of sectoral laws, national guidelines, decrees and standards is still a challenge to national regulatory agencies. It was observed also that more emphasis on financing sanitation sub-sector is crucial. The types of sanitation found are on- site sanitation systems where traditional pit latrines are dominants with a proportion of 77.3% of households, compared to automatic flushing toilet with septic tanks of 15.3%, pour flush of 4.4% and VIP% of 2.9%. It was found that 92.8% have toilet facilities while 7.2% of households do not have toilet at all. Majority of the households (74.35%), strongly agreed to accept options for improved sanitation systems, and VIP latrines were recommended in this concern.

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LIST OF ACRONYMS AND ABBREVIATIONS

ABEDA	Arabic Bank for Economic Development for Africa
ADB	African Development Bank
AEPE	Alimentation en Eau Potable et Electricité (Water Supply and Electricity)
ATP	Applied Training Project
CDF	Community Development Fund
CEPEX	Central Public Investment and External Finance Bureau
CLTS	Community – Led Total Sanitation
CHU/K	Centre Hospitalien Universitaire de Kigali (University Hospital Centre of Kigali)
CoK	City of Kigali
COMESA	Common Market for Eastern and Southern Africa
COOPED	Coopérative pour l'Environnement et Développement (Cooperative for Environment and Development)
CSR	Caisse Social du Rwanda (Social Security Fund of Rwanda)
DHS	Demographic Health Survey (Enquete Demographique de Sante, EDS)
DRC	Democratic Republic of Congo
DR Congo	Democratic Republic of Congo
EAC	East African Community
EICV1	Enquête Intégrale sur les Conditions de Vie des Ménages, 2001/2 (Households Living Conditions Survey, 2001/2)

EICV2 Enquête Intégrale sur les Conditions de Vie des Ménages, 2005/6 (Households Living Conditions Survey, 2005/6)

ECOSAN Ecological Sanitation

EDPRS Economic Development and Poverty Reduction Strategy

EU European Union

FIDA Foundation of International Development Assistance

GDP Gross Domestic Product

GoR Government of Rwanda

HAMS Hygiène et Assainissement en Milieu Scolaire (Hygiene and Sanitation in schools)

HIMO Haute Intensité de Main-d'Oeuvre (Labour-Intensive Public Works)

IDWSSD International Drinking Water Supply and Sanitation Decade

IMR Infant Mortality Rate

IWRM Integrated Water Resources Management

IYS International Year of Sanitation

KIST Kigali Institute of Science and Technology

MTIF Medium Term Expenditure Framework

M Million

MDGs Millennium Development Goals

MIGEPROF Ministry of Gender and Family Promotion

MINAGRI Ministry of Agriculture and Animal Resources

MINALOC Ministry of Local Government, Good Governance, Community Development and Social Affairs

MINECOFIN Ministry of Finance and Economic Planning

MINEDUC Ministry of Education, Science, Technology and Research

MINICOM Ministry of Commerce, Industry, Investment Promotion, Tourism and Cooperatives

MININFRA Ministry of Infrastructure

MINIRENA Ministry of Natural Resources (Former MINITERE, Ministry of Lands, Human Resettlement and Environmental Protection)

MMR Maternal Mortality Rate

MINISANTE Ministère de la Santé (Ministry of Health)

NBI Nile Basin Initiative

NEPAD New Partnership for Africa's Development

NG National Goal

NGOs Non Governmental Organizations

PHAST Participatory Hygiene and Sanitation Transformation

PPP Public Private Partnership

PRSP Poverty Reduction Strategy Paper

RBS Rwanda Bureau of Standards

REMA Rwanda Environment Management Authority

ROEC Reed Odorless Earth Closet

RoR Republic of Rwanda

RURA	Rwanda Utilities Regulatory Agency
RWF	Rwanda Francs
SIDA	Swedish International Development Authority
SNV	Netherlands Development Organization
SSFR	Social Security Fund of Rwanda
U5MR	Under Five Mortality Rate
UN	United Nations
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
USD$	United States Dollars
VIP	Ventilated Improved Pit Latrine
WASH	Water and Sanitation Hygiene
WATSAN	Water and Sanitation Sector
WB	World Bank
WHO	World Health Organization
WSP	Water and Sanitation Programme
WSSD:	World Summit on Sustainable Development in Johannesburg

GLOSSARY

Akagari	Cell
Umudugudu/imidugudu	Village/s
Umurenge/imirenge	Sector/s

CHAPTER ONE

INTRODUCTION

1.1 Background information

"Access to sanitation is deeply connected to virtually all the Millennium Development Goals, in particular those involving the environment, education, gender equality and the reduction of child mortality and poverty," UN Secretary-General Ban Ki-moon said. "An estimated 42,000 people die every week from diseases related to low water quality and an absence of adequate sanitation. This situation is unacceptable."

Sanitation services have been combined with water supply services for quite long time. However, in most cases water supply has been emphasized on only paid lipservice to sanitation. The challenge is aggravated by the fact that there is no direct benefit in sanitation services as compared to water supply. However, improved sanitation has positive impacts on economic growth and poverty reduction. This was motivated by UN's decision which declared 2008 as International Year of Sanitation (IYS). According to a recent WHO study, every dollar spent on improving sanitation generates an average economic benefit of $7. The economic cost of inaction is astronomical. Without improving sanitation, none of the other Millennium Development Goals, to which the world has committed itself, will be achieved.

According to the United Nations Millennium Development Goals, improved sanitation is defined as access to facilities that hygienically separate human excreta from human, animal, and insect contact. The seventh Millennium Development Goal covers among others, improvement in accessibility to sustainable safe water and sanitation, the specific target set for the provision of water supply and sanitation services is to halve the proportion of people without access to safe drinking water and basic sanitation by 2015. The Joint Monitoring Programme of WHO/UNICEF and the UNDP Human Development Report (2006) show the progress towards meeting the MDG sanitation target is however much too slow, with an enormous gap existing between the intended coverage and today's reality especially in Sub-Sahara Africa and parts of Asia. The reasons for this are numerous. A major issue is the fact that sanitation rarely receives the required attention and priority by politicians and civil society alike despite its key importance for a society. Political will has been largely lacking when it comes to placing sanitation high on the international development agenda. This has pushed sanitation into the shadows of water supply projects for example, and limited innovation in the sector.

The urgency for action in the sanitation sector is obvious, considering the 2.6 billion people worldwide who remain without access to any kind of improved sanitation, and the 2.2 million annual deaths (mostly children under the age of 5) caused mainly by poor hygienic conditions and sanitation-related diseases such as cholera, hepatitis, typhoid, and diarrhea. More than half of the world’s rivers, lakes, and coastal waters are

seriously polluted from wastewater discharge (UN Environment Programme, 2002). The cost of inadequate sanitation translates into significant economic, social, and environmental burdens. (http://www2.gtz.de/Dokumente/oe44/ecosan/nl/en-susana-joint-road-map-iyos-2008.pdf).

The situation in Africa demonstrates the biggest challenge ahead in meeting the MDG. The continent has the lowest water supply and sanitation coverage of any region in the World. More than 1 in 3 Africans residing in urban areas currently lack access to adequate services and facilities. In the year 2000, coverage levels for water supply and sanitation were 62% and 60% respectively (Source: Global Water Supply and Sanitation Assessment Report, 2004, WHO, Geneva.)

Rwanda is one of the countries located in Sub-Saharan Africa, in the East African great lakes region and is committed to achieve adequate sanitation goal and has set national goal encompassing sanitation MDG. The goals are set in Rwanda vision 2020 and Economic Development and Poverty Reduction Strategy (EDPRS), short term strategy of five years starting from 2008 up to 2012. The national goals set are the road map to meet MDGs by 2015. However, according to 2006 MDG report, it is required to double efforts to meet sanitation MDG and National sanitation target.

Sanitation systems in this study refers to sustainable and hygienic sanitary means of disposing of human excreta, but the discussion of other related aspects such as water supply, wastewater management are also considered significant.

1.2 Problem statement

Sanitation problems in Kigali City are associated with a contaminated water supply and a lack of adequate sanitation facilities. The country possesses abundant water resources and 85% of existing water sources are believed to contain coliform contamination levels beyond the recommended limits. Even though over 80% of the country's population has access to latrines, only 8% of these meet hygienic standards, a factor to that contribute to coliform contamination. Waterborne diseases and poor hygiene related diseases are among diseases which present the greatest health burden on the individual household and on the country. They are major causes of morbidity and mortality amongst under-five where diarrhea (21%), is one of the top ten diseases causing the death of under-five. (Source: National Environmental Health Policy, 2007). Epidemics such as cholera, meningitis, bacillary dysentery, are related to poor hygiene and sanitation at personal, household and all of Kigali City community levels.

The condition of public toilets in CoK is also alarming and do not meet the population growth sanitary needs. As consequence most of human waste is disposed of where it should not, thus causing hygiene problems for the people. In addition to this, Kigali has

no single central sewer system for municipal, industrial and domestic wastewater and there are practices of disposing domestic wastewater and other waste in open drainage “ruhururа”. As a result, big volumes of wastewater produced in the city, is either discharged untreated into Nyabugogo river and into wetlands surrounding the city or absorbed into ground water, polluting fresh and ground water resources as well as soil. Several studies have been done on water supply and sanitation ie E. Kabalisa 2007, *Water Supply and Sanitation situational analysis and way forward proposal for Kigali City, Rwanda,* Univeristy of Dar es Salaam, but lack of emphasis on sanitation is still a challenge as it has been always pushed under the shadows of water supply.

1.3 Objective of the study

The research main objective is to analyze experiences and practices with respect to technology, provision and management of sanitation systems in Rwanda particularly in the Capital city, Kigali. It is also aimed at demonstrating the impacts of different sanitation systems based on a varied set of comparable function criteria. The findings will serve as a valuable source of information for viable sanitation systems advocacy and awareness among practitioners and policy and decision makers. Issues to be addressed as specific objectives include:

- ✓ To analyze the management structure for the provision sanitation services
- ✓ To analyze sanitation needs technologies for Kigali City and within the context of IWRM to suggest technologically feasible ones for the City

- ✓ To assess the acceptability of sanitation systems looking at related reforms in the sector and their impacts

1.4 Research questions

This research is aimed at providing answers to the following questions:

- How is the management of sanitation services and provision in Kigali, Rwanda?
  a. Who are key stakeholders and their responsibilities in the provision of sanitation services in Rwanda especially in the capital city?
  b. How are financial resources allocated to sanitation sub-sector?
  c. What are legal framework and policies that are currently governing sanitation sub-sector in Rwanda?
- Are the available sanitation systems technically feasible?
  d. How many people do have access to sanitations facilities? What type per household?
- How acceptable are sanitation systems in Kigali?
  e. Are people satisfied with existing sanitation facilities, if not what would they opt for alternatives? Are they willing to participate in their provision?

1.5 Significance of the study

The city of Kigali is a rapidly- growing city as a result of changes in the socio-economic policies of the government. According to the 1991 population census, only 6% of the population lived in urban areas. However, in 1999 the urban population was estimated to be between 10% - 12%. This rapid population growth increased drastically the demand for housing and other urban services including sanitation services. It is also observed from the studies that after the 1994 genocide, the development of the city of Kigali has been unstructured, uncontrolled and haphazard. The results of this include inefficient land use, inefficient use of limited resources, and a negative impact on the environment as well as on social and security conditions. Increasing urbanization is slowly bringing with it the problems of pollution due to increased poor waste management and insufficient sanitation systems. Improved sanitation facilities will eliminate the causative agents of water and excreta-related diseases. In communities such as kigali city, where there is constant contact with the polluted environment, sanitation is an important concern. Improved sanitation systems are crucial and will protect the health and improve the environment of Kigali City community.

1.6 Scope of the study

The scope of analysis of sanitation systems is not limited to the operational definition of proper disposal of human waste (excreta) and the construction of latrines. The study encompasses some community hygiene practices, socio-economic considerations and

institutional requirements. This helps to recommend the most appropriate technologies for the urban community. The study does not touch the central systems of wastewater management. It focuses on improvement of individual sanitation systems and community based systems. Since specific findings are based on the case study, it must not be assumed that they are applicable in other cities. Only general recommendations are provided in the larger context.

1.7 Description of the study area

1.7.1 General

Figure 1.1: Africa Map and the Location of Rwanda

Source: Atlas du Rwanda

Rwanda is a landlocked country located between the eastern and central Africa. It is surrounded by Tanzania to the east, DRC to the west, Burundi to the south and Uganda to the north (see Figure 1). The country has 26, 338 sq. Km of total area with a density of 311 inhabitants per sq. Km. The altitude is less than 1500 metres in the eastern plateau but rising to between 1500 and 2000 metres in the west and north.

The mean daily temperature is close to 24 C (76F) and the minimum night temperatures is around 10C (50F) and maximum daytime temperatures ranges about 34C (94F). The climate of Rwanda is made up of two wet seasons and two dry seasons. The annual rainfall varies from 700 mm to 1400 mm in the East and in lowlands of the West, from 1200 mm to 1400 mm in central plateau and from 1300 mm to 2000 mm in the high altitude region with an average of 1200 mm per year.

The country possesses water in abundance (lakes, rivers and swamps). Surface water covers 211,000 hectares equivalent to 8% of the total national territory, with rivers occupying an area of 7,270 hectares and 22, 300 natural springs that feed into rivers and lakes. These rivers meanders between hills and ridges scattered all over the country, the reason Rwanda is famously known as the “country of a thousand hills”. (Source: Water and Sanitation Sector Performance Report 2006).

Rwandan working population situation is such a way that agriculture (88.6%); workers specialized in services (3.3%); laborers, non-agriculture unskilled workers and vehicle drivers (3.1%); Business and traders (2.6%); Professionals and assimilated associates (1.6%); and Manufacturing industry (0.8%). (Source: 3rd General Census of Population and Habitat (RGPH) conducted in August 2002).

1.7.1.1 Socio-demographic and economic features of Rwanda

- **Socio-demographic data**

The country's population size of 8, 128,553 inhabitants composed of 3, 879,448 males (47%) and 4,249,105 females (52,3%) representing a physical density of 309inhab/ km^2 with an average of annual growth rate of 2.8% and urban population is 16.9% of the total (3^{rd} General Census of Population and Habitat (RGPH) conducted in August 2002). Rwanda is one of the highest densities in Africa where population growth exerts enormous pressure on natural resources. Taking into account the education level of the population, overall, 29% of women and 22% of men in the households, age 6 and up, have never attended school. Literacy varies significantly according to the area of residence. In urban areas, 16% of women and 13% of men are illiterate versus 32% and 24%, respectively, in rural areas. The city of Kigali has the highest literacy rate with 85% of women and 86%of men literate. (Source: 2005 Demographic and Health Survey)

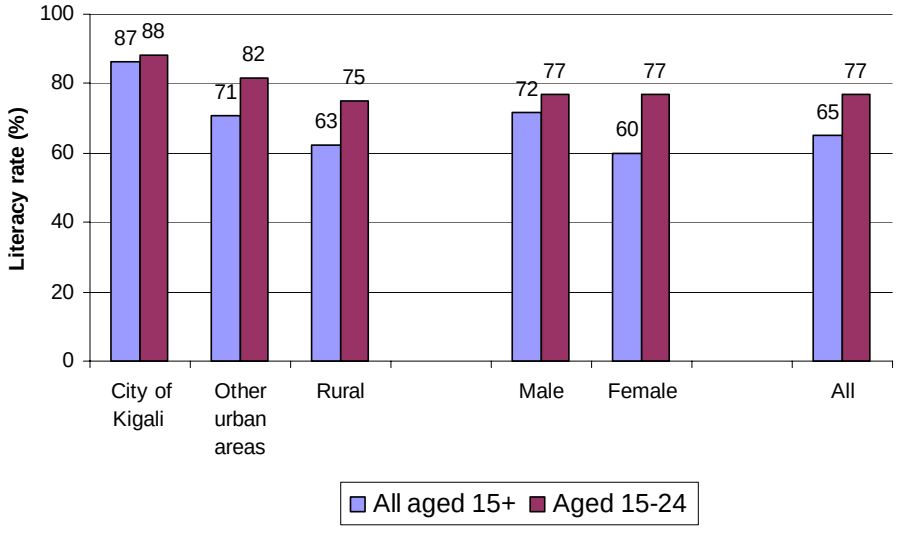

Figure 1.2: Literacy rate (%)

Source: EICV2. Note: These figures are based on reported literacy, i.e. asking people whether they could read and write a letter. People did not have to undergo a test. But the results for people aged 15–24 are similar to those of the DHS 2005, which did administer a test (the DHS does not ask the question for everyone over the age of 15).

- **Economic aspects**

From the economic point of view, Rwanda's poverty is high. Its economy is basically agricultural. More than 90% of the population depend on peasant subsistence agriculture which contributes 40% of GDP estimated at 210 US$ in 2000 and 90% of export earnings. The industrial sector is still in its early stages. The secondary sector employs 2% of the working population, 0, 2% of whom are women. The services sector employs not more than 6.6% of the population, 4.1% of whom are men and 2.5% women. The informal sector represents 79,8% of employment and the public and parastatal sector represents only 2, 4% in the CoK. The unemployment rate continues to rise and sources of monetary income are increasingly becoming rare. Economic conditions of the population are becoming worse and poverty is steeply rising.

1.7.1.2 Human settlements

Human settlements constitute the basic physical infrastructure for the overall development of the country. In Rwanda, there are rural human settlements and urban human settlements, both of which are characterized by unplanned occupation of space.

- **Rural settlements**

For years, rural settlements in Rwanda have been and continue to be scattered in some regions of the country. For a long time, they have been characterized by unplanned occupation of space, thus doing harm to environment by wastage of land and soil erosion. However, in December 1996, the Government adopted a national human settlement policy aimed at establishing an improved rural human settlement model, grouping settlements in villages generally known as imidugudu, which meet the criteria of environmental viability through the reorganization of the national space, land reform, improved housing quality, etc.

- **Urban settlements**

The urbanization policy aims at discouraging the proliferation of unplanned residential areas with a view to improving sanitary and security conditions, providing decent houses and socio-economic infrastructure. Commendable efforts have been made in the development of town master plans aimed at resolving problems caused by unplanned residential areas, while meeting the requirements of modern urbanization, taking into account environmental concerns.

1.7.2 The City of Kigali

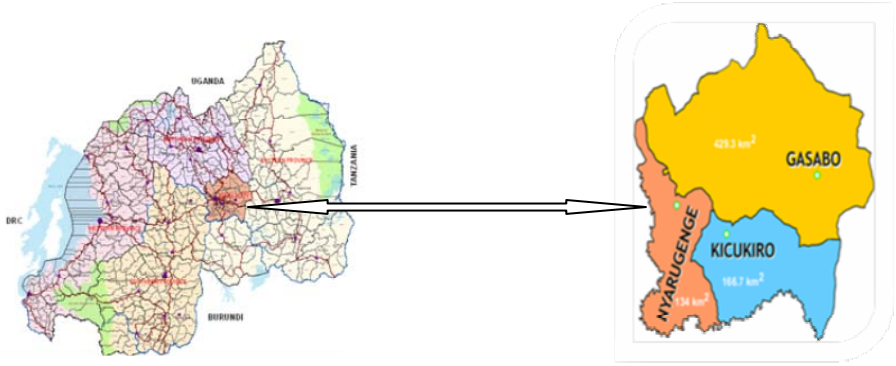

Figure 1.3: Administrative map of Rwanda
Source: *http://www.rwandagateway.org*

Figure 1.4: Map of Kigali City
Source:
http://www.kigalicity.gov.rw

Kigali is the capital and commercial city of the Republic of Rwanda where the study was conducted from. It covers an area of 730km^2 with one million inhabitants. Kigali City is located on Rwanda's central plateau of the country with a status of a province. Kigali City, which started in 1907 as a small colonial outpost with little link to the outside world, is now 101 years old. Kigali is built in hilly landscapes sprawling across ridges and wet valleys in between.

Big structures like the universities, banks, hotels, international organizations, embassies, government offices, commercial buildings and residential areas of affluent people tend to be built on top of the ridges while the poorer people live down towards the valley. Located at Rwanda's geographical heart, the rapidly growing City of Kigali is not only

the national capital, but also the country's most important business centre and main port of entry. Its average temperature is 19ºC (66F) with 40 inches or 1000 mm of rainfall annually. (Source: Rwanda, Enquete Démographique de Santé (EDS): UNAIDS 2000). Its geographical position is on latitude 1º 57'S and on longitude 30º 04' E. Kigali is situated in the natural region called Bwanacyambwe within the proximity of the Nyabugogo river basin, between Mount Kigali (1852 m high) and Mount Jali.

Administrative divisions: The actual urban provincial boundaries of Kigali as defined by the decree No. 896/90 of 1990 was composed of three communes (districts) namely Nyarugenge, Kicukiro, and Kacyiru. These communes comprised of a total of 20 Sectors and 91 Cells. The city stretches from the centre to form bigger three districts. Nyarugenge, Kicukiro and Gasabo which are composed of 22 sectors in total. Due to decentralization policy implementation, the sector level is considered to be the development harbor where districts are responsible of development projects and decision making.

Population: Kigali is a rapidly growing City, its population has been growing over the last two decades, but a new growth trend developed after the 1994 war and genocide, when there was a dramatic rise in the population. The population growth of Kigali City was estimated by different surveys carried out throughout the country as follows: In 1960, the population was 6,000 peoples growing to 235,664 in 1991 and more than doubled between 1991 and 2000 reaching a figure of 604,966 people. It is further

observed that in 2000, women constituted about 52 percent of the city's population and that about 56 percent of the entire City's population was age below 20 years. They gives a dependence ratio of 1.4:1 i.e. the population which is below 20 and above 60 compared to that between 20 and 60 years of age.

The CoK is presently inhabited by approximately 1 million inhabitants. Kigali is 70% rural with a population which is relatively young- the youth make up about 60% and women make slightly more the 50%. The actual City population's annual growth is estimated to be 10%. The population growth in the city will continue at this high rate because of the rural to urban migration tendency. It is estimated in the Kigali City Master plan 2020 that only 43 percent of the city population were originally natives of the city, while 56.8% had migrated from other areas.

Family Composition and Size: Kigali City is estimated to have 200,000 households and a total population of approximately 1 million inhabitants. The average size of household is therefore 5 persons. It is estimated that 51% of heads of household are male while 44% are women and 5% are children.

1.8 Outline of dissertation report

After introduction which includes background information, problem statement, objective and research questions, significance, scope of the study and the description of

the study area, the rest of this study report is organized as follows: Chapter two is basically composed of literature review which details relevant theories and concepts which make the basis of this study. Chapter three describes the methods and materials used to collect data. Chapter four presents main findings of the research and discusses the results while the final chapter (five) provides conclusions and recommendations, basing on the findings of this study.

CHAPTER TWO

LITTERATURE REVIEW

Chapter two presents conceptual and theoretical framework which constitute the basis of this study. Concepts and theories relevant to this study are developed with the help of the existing literature and relevant documents which were collected and reviewed during data collection period in the study area. It provides a brief introduction to available low-cost sanitation systems and identifies which improved sanitation systems have been applied in different cities.

2.1 Understanding sanitation

2.1.1 Composition and reuse

Understanding sanitation requires understanding human excreta's composition, hazards to human health, and potential for reuse. Human excreta are feces and urine, which consist of proteins, carbohydrates, and fats. Excreta contain moisture, organic matter, nitrogen, phosphorous, potassium, carbon, and calcium (Gotaas (1956) and Mara (1976)). Excreta also contain pathogens that cause infectious diseases such as cholera, hepatitis, typhoid, schistosomiasis, and diarrhea through fecal oral contamination. Helminthes (worm-like parasites, including human hookworms, roundworms, and whipworms) cause gastrointestinal infections that make up part of the excreta-related global health burden (Mara, 2004). It is estimated that approximately one-third of the

world population has intestinal worms (Chan, 1997). The loss of blood from a human hookworm leads to iron-deficiency anemia and protein malnutrition, particularly in women of reproductive age and children.

The discharge of untreated sewage into water resources provides a vector for pathogens capable of sickening humans and animals. Pathogenic bacteria are able to survive in bodies of water for days or weeks, and eating contaminated seafood can cause typhoid fever, infectious hepatitis A and B, polio, and cholera (GESAMP, 2001).

Table 2.1: Annual excretion of one human, compared with the amount of fertilizer needed to produce cereal

Fertilizer	500 liters urine	50 liters feces	Total excreta	Fertilizer needed for 230 kg of cereal
Nitrogen	5.6 kg	0.009 kg	5.7 kg	5.6 kg
Phosphorus	0.4 kg	0.19 kg	0.6 kg	0.7 kg
Potassium	1.0 kg	0.17 kg	1.2 kg	1.2 kg
Total (N+P+K)	**7.0 kg (94%)**	**0.45 kg (6 %)**	**7.5 kg (100%)**	**7.5 kg (100%)**

Source: Wolgast (1993), quoted in Austin & Van Vuuren (2001)

These pathogens are particularly deadly in developing countries; diarrhea alone kills some 1.3 million children under the age of five each year. The WHO estimates that poor sanitary conditions and practices cause 85–90 percent of diarrheal cases in developing countries (Prüss-Üstün et al., 2004).

Many low-cost technologies are able to treat excreta and sewage so that it can be reused. Reducing pathogens, particularly human intestinal nematodes and fecal bacteria, is the most important step in treating human waste. The WHO's guideline limit for fecal coliform bacteria is 1000 per 100 milliliters (Havelaar et al., 2001). The Endgelberg guidelines limit nematodes to no more than one egg per liter. Once these standards are met, human excreta can be reused as fertilizer or for aquaculture. Table 2 above illustrates the potential value of excreta as a productive resource: One person's annual average excreta 500 liters of urine and 50 liters of feces equals the amount of fertilizer needed to produce a year's worth of cereal for one person (230 kilograms).

2.2 Low-Cost Sanitation Technologies

Recent studies in sanitation identified several low-cost sanitation technologies. These excreta-disposal systems offer different degrees of user convenience, protection against the spread of diseases and water demand for their operation. They can be classified in several ways. A basic classification is based on whether the waste is disposed of within the site or is transported somewhere else. Under this classification, the technology is either on-site or off-site systems. On-site sanitation systems include those in which safe disposal of excreta takes place on or near the plot or site of the toilet. Systems included in this classification are; overhung latrines, trench latrines, pit latrines, Reed Odorless Earth Closet (ROEC), ventilated improved pit latrines (VIP), composting latrines, pour-

flush latrines, and septic tanks. Off-site sanitation systems include those in which excreta are collected from the individual toilets and carried away from the plot to be disposed of. Vault and cartage and bucket latrine are included in this category. Some of these systems involve the use of water and are therefore classified as wet systems. Others disallow the use of water, even for hygienic purposes, and are therefore classified as dry systems.

Another way of classifying sanitation systems is through their application as either individual household sanitation technologies or community sanitation technologies. Systems that are classified as household sanitation systems include the pit latrine, pour-flush toilets, composting toilets, aquaprivies and septic tanks, which are built in individual houses. Systems such as bucket latrines, vault toilets with vacuum-cart collection, communal toilets and sewerage systems are classified as community sanitation facilities.

2.2.1 Available sanitation systems based and their classification

Taylor, Parkinson and Colin (2004), classify sanitation systems on the basis of waste disposal, use of water and nature of water treatment at source.

2.2.1.1 Sanitation systems based on water use

- **Dry sanitation systems**

Dry sanitation systems do not use water as a carrier; instead, excreta are broken down by anaerobic methods either through decomposition or dehydration. In decomposition systems, bacteria, worms, and other organisms break down urine and feces. Dehydration systems separate urine and feces, and then scatter feces with ash, shredded leaves, or sawdust to absorb excess moisture and deodorize. The added material also improves the nitrogen content in the event that the feces are reused as fertilizer (Del Porto and Steinfeld (1999), Esrey et al. (1998), and Drangert et al. (1997)).

- **Decomposition Systems: Pit Latrines and Ventilated Improved Pit (VIP) Latrines**

Pit latrines are the most rudimentary form of sanitation. Structures made out of locally available materials cover a defecation hole, a pit dug in the ground to collect waste. Once full, the pit is covered with sediment. The water table should be no less than 0.5 meters below the surface of the pit or it could contaminate the ground water. Geological conditions are a primary concern when considering a pit latrine; rocky substrates and shallow water tables negate this option for many communities, and areas with non-cohesive soils require a lined pit. The health problems posed by pit latrines have been widely documented. (Grimason et al. (2000), WHO (2004), Intermediate Technology Development Group (2003), and Bakir (2001)).The open defecation hole attracts mosquitoes and flies and produces a ghastly odor. Pit latrines often serve as breeding

grounds for mosquitoes, thus increasing the incidence of malaria in some areas. These adverse conditions lead many communities to abandon latrines.

Ventilated Improved Pit (VIP) latrines are an improvement over traditional latrines in two important respects: they mitigate the noxious odor and reduce the number of flies and other insects that plague users of traditional latrines. In a VIP latrine, a vent pipe allows fresh air to flow through the latrine, reducing odor. The vent also allows light into the latrine, attracting insects into the pipe, where they are trapped by the fly screen at the top of the pipe. The screen also keeps out insects looking to enter the pipe from the outside. The VIP latrine has been successfully used in Zimbabwe since the mid-1970s, where it is known as the Blair Latrine (Robinson, 2002).

Other dry decomposition options utilizing anaerobic breakdown have been developed to allow excreta to be reused for agricultural purposes. If VIP latrines are constructed with two pits, instead of moving the latrine when the pit is full, users switch to the other pit. After the waste in the full pit composts, it can be reused as fertilizer. The amount of time before the compost can be used as fertilizer depends on climate and ranges from 3–12 months. *Although pH level and time are the most important factors, the rate of pathogen destruction is also influenced by temperature, competition for nutrients, antibiotic action, and toxic byproducts of decomposing organisms (Winblad, 1985).*

Other decomposition toilets include Reed's odorless earth closet (ROEC), the Clivus Multrum, the Pacific Island Carousel toilet, and the Mexican SIRDO. Variations in design include the use of aboveground vaults (constructed of concrete, brick, or other materials), solar energy to heat the compost, different seat designs, electric fans, mechanical vault rotation, and alternate vault locations. The vaults themselves can be emptied by hand or by mechanical means (e.g., with a vacuum). One of the lessons learned from the first Water and Sanitation Decade is the importance of keeping the latrine affordable (Cairncross, 1992). However, the product must also be desirable and able to serve the community's needs a delicate balance.

- **Dehydration Systems**

Dehydration systems separate urine and feces using a special pedestal or urine diversion pan. Urine is diverted into a holding pot or into a soak field, while a watertight vault collects the feces. After defecation, ash or another absorbent (e.g., lime, dry soil, husks, organic matter) is sprinkled into the vault. Material used for anal cleansing is put into another container rather than dropped into the vault. Once the vault is three-quarters full, the feces is covered with dry earth. Both the urine and the dehydrated feces can be reused as fertilizer. Urine is often used immediately, but it should ideally sit for six months to ensure that nematode eggs are destroyed. Dehydrated feces should not be used for at least a year, although case studies identify different amounts of storage time.

One advantage of dehydration systems is better groundwater protection due to the use of watertight and above ground vaults, which can be used in areas that have geotechnical limitations. The absorbent material also helps to deodorize the chamber and reduce flies. Dehydration can be employed in a wide range of climates. Due to the specific nature of the technology, however, the most common problem is moisture entering the dehydration chamber, either from leaks, urine splashing into the chamber, or other accidental spills. Children might find the latrines more difficult to use, and blocked urine separators also pose problems. The Vietnamese double-vault latrine has been in use since the mid-1950s, and dehydration systems can be found in South Africa, China, Mexico, El Salvador, Ecuador, Yemen, Guatemala, Ethiopia, Zimbabwe, and Sweden. Specific models include the Mexican Dry Ecological toilet, the Ethiopian EcoSan toilet, and the EcoSanRes.

Depending on the materials available, the urine diversion pedestals can be constructed or prefabricated from concrete, plastic, and fiberglass. Models such as the Mexican Dry Ecological toilet can be designed for use inside a home, complete with a conventional toilet seat (Esrey et al., 2000). In Yemen, a one-chamber dehydrating toilet has been adapted for use in a building that has several floors (Winblad, 1985). Solar panels, ventilation pipes, and other building materials can be used to tailor this technology to a community's specific needs.

- **Health aspects of dry sanitation systems**

Unfortunately, no systematic analysis documents the rate of pathogen and nematode egg die-off in dry sanitation systems. Anne Peasey (2000) reviewed the existing literature on the subject and found that the two most influential factors are pH level and the amount of storage time needed before the material can be reused, which varied from 3–12 months. A study cited by Strauss and Blumenthal (1990) asserts that 10–12 months are needed in tropical regions, while 18 months is suggested for highland areas. Studies of the prevalence of nematode eggs also did not take into account the health of the users, which is crucial to determining whether nematode eggs were already present. This lack of information could be significant, depending on the product's end use. In areas where a proportion of the population hosts intestinal worms, secondary treatment may be necessary.

❖ **Wet sanitation systems**

Wet sanitation systems utilize water to treat waste. These methods are only recommended for communities that have liberal supplies of water. The most widely used models are the pour flush latrine, the aquaprivy, and the septic tank. These systems are usually more expensive than the VIP latrine, although some argue that the cost of the pour flush latrine is comparable. Primary treatment produces effluent and sludge; ability to reuse the effluent depends on household land-use patterns. However, a second treatment using natural processes can be easily achieved.

- **Pour flush latrines**

A pour flush latrine consists of a cover slab and a special pan that provides a water seal. A U-shaped pipe is used to maintain the water seal. Approximately 1–3 liters of water are needed for each flush. The latrines can be constructed with pits directly underneath or offset, or with two pits. They can also be built inside a dwelling, with the pit located outside. If properly built and maintained, pour flush latrines reduce odors and flies. They should be considered in communities where anal cleansing habits require the use of water. Disadvantages of pour flush latrines include the high water requirements, higher cost, and problems caused by clogged pipes. The pour flush latrine is used in parts of Asia and the Caribbean, and most widely in India, where it is called the Sulabh toilet (Jha, 2005). The Sulabh toilet replaced the bucket system, saving more than 60,000 people (mostly women) from manually handling waste. In addition, public pour flush latrines connected to biogas plants generate electricity.

- **Aqua privy**

An aquaprivy is an underground watertight tank, filled with water, which is connected to a flush toilet or defecation hole. The tank is located directly underneath the toilet and separates solid matter from liquids. The tank can also be used to dispose of greywater. Over time, the solid matter in the tank degrades anaerobically. A soak field absorbs the effluent; however, sludge must be removed from the tank every 1–5 years. Usually a vacuum tanker or service crew performs this difficult and potentially dangerous task. A

bucket of water must be poured down the drop pipe daily to clear any buildup and maintain the water seal. Aquaprivies, found in more than 39 countries, can be set up inside a home and connected to a sewage system at a later date (Brikke et al., 1997). If operated properly, there are usually no problems with flies or odors. The tank must be maintained; if the tank is leaking, odor can become a problem. The aquaprivy, which requires the use of water, is more expensive than the sanitation methods discussed above. The soak fields used by aquaprivies and septic tanks can also cause problems, which are described below.

- **Septic Tank**

A septic tank is similar to an aquaprivy, except that a septic tank can be located outside the house. The toilet used with a septic tank also has a U-trap water seal. As with the aquaprivies, septic tanks can be used to dispose of greywater and must be periodically emptied of sludge. They also require the use of a soak field for the secondary treatment of effluent. Septic tanks may have two chambers to separate and promote further settlement of liquid and solid excreta. Septic tanks are more costly than aquaprivies; given the higher initial investment required, plus the recurring costs of emptying the tanks, this method is not generally recommended for poor rural communities. For peri-urban areas, the ability to connect the household to a sewage system at a later date is a major benefit. The disadvantages include faulty or leaking septic tanks, water requirements, higher costs, and the use of a soak field. If the septic tank is faulty, flooding can cause hydraulic overloading. Septic tanks are used widely across the

United States; it is estimated that only 4–6 percent of these tanks are watertight. U.S. EPA (2002) estimates suggest that 10–20 percent of these systems are failing and that rates of groundwater contamination may be even higher.

2.2.1.2 Sanitation systems based on waste disposal

A simpler way of understanding different types of sanitation systems is to think of them as primarily on-site and off-site systems that are each sub-divided into wet and dry systems respectively. It is important to note that none of these classification systems take into consideration the method of anal cleansing, which varies widely from country to country. Indeed, whether on-site or off-site, a dry sanitation system could use water for cleansing while a wet sanitation system could use toilet paper, leaves or other methods for the cleansing.

- **Off – site and centralized sanitation systems**

In cities of developed world, during the last decades most of sewer pipes have been connected to waste water treatment systems before the wastewater is discharged in open waters (van Vliet, B., 2004). Centralized sanitation system consists of sewer network which transport waste water from a household to a treatment plant and the effluent is discharged in the environment. They are sometimes called conventional sanitation systems because they have been in existence and dominant technology for many years and most of institutions and policies that tend sanitation in cities of the west and developing countries are based on these systems.

Proponents of centralized sanitation claim that they are more hygienic than traditional decentralized systems. Another advantage of centralized sanitation systems according to their promoters is that they are more convenient (“flush and forget”). While Sewer pipes are connected in all areas of cities and towns of developed world, most parts of cities and towns in developing countries has not been connected to treatment systems and this results in sewer pipes discharging untreated effluent into fresh waters in sea, lakes, natural ponds and river streams (Spaargaren, G., at al, 2005). This trend in poor countries is due to the fact that centralized or off-site networks with treatment facilities need high investment (Krekeler, T., 2005). Most developing countries lack financial resources therefore can not afford centralized sanitation systems because of the high cost of physical infrastructure which include a network of pipes and treatment plants and the maintenance. Most centralized infrastructure in developing countries if exist were built during colonial period. They only cover initial sections of the city and have not had maintenance since then.

Off-site sanitation systems are appropriate for large scale exploitation, based on technical and economic feasibility studies (sewer networks, runoff water drains, etc). High costs and the need for in-house water supply have been the main problems centralized systems or conventional sewer systems. Costly centralized sanitation systems are not a problem for developing countries alone. In developed countries, because of high maintenance cost while there is little profit returns, centralized or off-

site water and sanitation systems are directly cross subsidized and the chances of ever become financially sustainable are low. Toilets alone in European countries consumes one third of personal daily water consumption (Henze, M., 1997); and according to Lettinga et all, (2001) only 5% of treated drinking water are used for essential uses like cooking and drinking while the remaining 95% is used for transporting waste water to treatment facilities.

From social perspective, centralized utilities do not recognize the role of social actors or consumers in the sustainability of the systems because they are designed on technological and economical biased approaches. According to B. van Vliet, (2006), Centralized sanitation systems are large technical systems whose management systems seems to be restricted to big actors, like managers, regulators, NGOs and the likes while citizens-customers are the subjects of change, qualified as end-users, consumers or simply ‘ the demand side’.

- **On – site and decentralized sanitation systems**

On-site sanitation is the whole of actions related to the treatment and disposal of domestic waste water that cannot be carried away by an off-site sanitation system because of low density of population. When a house (plot) makes use of the soil as a treatment medium (example of soak-away, latrines, etc), it is then recognized as individual on-site sanitation where as when many individual houses are linked to a network leading to a treatment system, or small communities grouped is known as on-

site sanitation (or semi off-site sanitation),: grouped sanitation doesn't always use the soil as treatment medium (filtration beds, activated sludge are examples of purification systems at the end of the chain). (http://www.oieau.fr/ReFEA/module3b.html).

The autonomous part of on-site sanitation refers to the techniques used in wastewater treatment and disposal, design, as well as its financing, implementation and maintenance. The techniques used normally are low-technologies; therefore they don't need expert maintenance as well as management skills like centralized systems do. Decentralized systems systematically outperform centralized ones in financial efficiency and in their ability to increase coverage of basic services over time (Pearce-Oroz, 2006). These advantages are manifested in the current sanitation status in developing countries, including Rwanda where decentralized systems are the only sanitation systems in existence.

On-site sanitation technologies used worldwide include Simple Pit or Traditional Latrines, Ventilated Improved Latrines (VIP), Ecological (Ecosan) latrines, Pour-flush latrines and Water closet toilets, connected to septic tank. These technologies are so far not well developed, as a result they still have disadvantages such as soil and ground water contamination with pathogens, bad odours, flies/mosquito breeding and potential pit collapse in cases of heavy rains. Other inconvenient drawbacks for these technologies are the distance from house, especially for women and children during night (Cairncross, S., 2003); and in a densely populated areas, the limits are obvious

that digging a new pit when the old one is full often leads to questions of where to build a new one (G. Spaargaren at al, 2005). What is obvious about all these technologies is that they are not water and energy intensive as compared to centralized technologies and that is why different researchers have conducted extensive research with the aim to promote these systems as being sustainable option to centralized sanitation system for the future (Lettinga et all, 1997).

On-site systems consist of several smaller units serving individual houses, clusters of houses or small communities. The wastewater treatment facilities are correspondingly smaller, e.g. for 20 - 10,000 population equivalent. Black and greywater can be treated or reused separately from the hygienically much more dangerous excreta. Installations with urine separation devices can also be integrated. For decentralized systems wastewater is treated in small non-centralized plants close to the place of generation and the effluent is then reused locally or discharged into surface waters, or the storm drainage system not requiring large sewer systems.

2.3 Comparative criteria in providing sanitation systems as per IDWSSD

Studies of appropriate technology for water supply and sanitation under the World Bank International Drinking Water Supply and Sanitation Decade, IDWSSD (1980-1990) defined several comparative criteria to introduce the putative performance of these technologies. Among these criteria are the following: water supply service levels; soil

condition requirements; cost; housing density; complementary investments; reuse potentials; environmental factors; self-help potential; and institutional constraints.

Recent studies on sanitation in developing countries identify some special requirements needed above the general criteria identified above. Nimpuno (1984) emphasizes operation, costs, construction, water requirements and urban adaptability as special considerations in the selection of sanitation technologies in developing countries. According to Nimpuno and Krisno, for the system to be acceptable in low-income communities in developing countries the following considerations must be met:

1. The daily operation should require minimal educational and technical instructions which can be taught to all ages. A simple, safe toilet routine should suffice for the daily operation of the system.
2. The construction costs should not exceed 10% of the total house investment.
3. The maintenance requirements be low that the construction require mainly local materials and be executed by semi-skilled labor.
4. The use of water to dilute and transport the excreta should be avoided since water is scarce and water treatment entails high cost; and
5. Since a great majority of the urban dwellers in developing countries do not have access to satisfactory excreta disposal systems, it is important to require that disposal systems are identified for existing housing areas. Application should also be possible in existing high density areas.

For existing low-income settlements without adequate sanitation facilities it is of great importance that small-scale, even individual, household installations can be chosen, that in time the individual provisions can be linked up to form a network, and that the systems can be upgraded gradually.

In actual sanitation projects, one of the causes of their failure is the overemphasis on technological installations at the expense of behavioral considerations such as latrine usage and upkeep and general hygiene practice of the users. In most of these projects, the stated priorities or goals often promote installation of facilities or numerical targets. Project planners pay little attention to the types of technologies acceptable to a given community, or to hygiene education needed to support the chosen option. Under these circumstances, it is more than simply a technical or economical analysis to the approach of providing adequate sanitation facilities. There is an element of deep-rooted cultural values which needs to be responded to in the process.

CHAPTER THREE

METHODOLOGY

3.1 Methods and materials

The methodology used for this research involved the case study approach and included the literature review and field survey as primary and secondary resource data. Primary data as data that are not in previous existence but are acquired directly from field was then obtained through key informants and other respondent interviews, survey questionnaires as well as field trip and observations. Secondary data were sourced from contemporary literature, official documents, as well as relevant web sites. Data obtained both primary and secondary were analyzed with the use of Microsoft excel, and results were presented in graphs and table. Techniques and methods used are key informant and responded interviews, field survey, household questionnaires and desk study.

3.1.1 Key informants and respondents Interviews

In gathering general information on the status of sanitation systems provision and management in Kigali City, key informants formal and informal interviews were performed. Sanitation sector being a cross-sectorial domain, there are many intervening parties such as state institutions, international organisms, NGOs, civil society and private sector are all concerned. Government officials and heads of sanitation units from different institutions and private companies operating in Kigali city were interviewed.

Among ministerial institutions of RWANDA, staff from major partners were interviewed ie those from Ministry of Natural Resources being an umbrella ministry responsible for sanitation issues. The head of sanitation unit in the ministry, the staff under PNEAR (Programme National D'alimentation En Eau Potable et d'Assainissement en milieu Rural), ministry program in charge of Water Supply and Sanitation in rural areas together with the former ministry staff in charge of sanitation and currently a national consultant in sanitation related projects was also interviewed.

Staffs from the ministry of finance (MINECOFIN) were interviewed especially those under budget department. The ministry plays a major role in preparing national budget and responsible for all program and project finances. Sanitation related goals under the Economic Development Poverty Reduction Strategy (EDPRS) were discussed about during the interview. This is the Government's medium-term strategy for economic growth, poverty reduction and human development, covering the period 2008 to 2012. EDPRS is the second medium-term strategy towards attainment of the long-term Rwanda Vision 2020 objectives. Other interviews were performed with the General Director of CEPEX (Central Public Investment and External Finance Bureau), and the staff responsible of the management of water and sanitation related project. The interviews were about finances allocation to sanitation project.

The ministry of health (MINISANTE) is in charge of mobilization and sensitization of good sanitation and hygiene practices. Interview was performed with the head of t of

Hygiene and Environmental Heath Unit. Statistics of water related diseases were obtained from the same ministry under the Department of Sanitation information Technology (Systeme d'Information Sanitaire).

Rwanda Environmental Management Authority (REMA), Rwanda Utilities Regulatory Agency (RURA) together with National Bureau of Standards (NBS) are public institutions which are in charge of establishing national standards and norms. Interviews about sanitation related norms and standards were performed with the Ag Director of Water and Sanitation Unit of RURA and other staff from REMA.

Since there is no sanitation unit in Kigali City Council, there was a privilege to interview some heads of Inspection and Urban Planning and Infrastructure Development UPID) units in charge of following up sanitation related issues. Interviews were performed with the Director of Inspection unit and other two staff working in the same unit. Staff from (UPID) unit was also interviewed. The Director of infrastructure in Nyarugenge District, was as well interviewed since the same department is the one responsible for sanitation related issues of districts in general.

ELECTROGAZ being responsible of water supply was consulted during data collection, the director of water Department was interviewed about the status of water supply in CoK. In this regards, the coordinator of AEPE (Alimentation en Eau Potable

et Electricite), was interviewed and was consulted about the status of the ongoing preparation of Sanitation master plan.

On behalf of NGO's, another interview was performed with an hygiene and sanitation specialist under Water and Sanitation program of World Bank-Rwanda. The Managing Director of COOPED and his administrator were interviewed about the management of liquid waste in the CoK.

Managerial issues which were points of concern for discussions and interviews included policies, regulation and laws of sanitation service provisions; Standards, procedures and specifications of sanitation services; Coordination of sanitation services as per its cross-cutting identifications; Government and non government investments is providing sanitation facilities and finally existing constraints in providing necessary sanitation services.

3.1.2 Field survey

Field survey was another method used to gather primary data. The survey involved field trips and field observations accompanied with interviews to officials responsible of sanitation service providers in different chosen institutions. A number of institutions were visited in order to identify different sanitation systems existing in the CoK and to know more about the management of the waste they produce. Both individual and public sanitation systems were visited in that regard.

Sanitation systems operating in Nyarugenge district were the ones visited most. This is because the most populated district and the head-quarter of Kigali city and home to big businesses and social activities such as banks, commercial and shopping streets, insurance companies, international organizations, some government ministries, colleges, the central Kigali prison, two referral hospitals, several dispensaries and some industries. Nyarugenge is always amassed by a lot of people who flock the city center from other districts of the city and up-country during business hours.

Sanitation systems of one of the biggest referral hospitals, (CHU/K) were visited. It is the one receiving majority of the patient in the city hence producing many different wastes. The academic institution selected was Kigali Institute of Science and Technology. This institute was chosen with the hypothesis that it is a large institute with over 4500 students and staff, and that it would be an ideal institute to represent other academic institutions of higher learning in the city of Kigali. One secondary school was also visited in Nyarugenge district (Ecole Secondaire, Lycee Notre Dame de Citeaux).

Sanitation systems in two hotels in Nyarugenge district were visited ie Serena hotel, a high-class hotel in Kigali City and Grace hotel a medium-class based in Biryogo. Different sanitation facilities in commercial places ie for kiosk and other busy places were visited. Public toilets are one of those visited sanitation systems. In addition to these, the Kigali common landfill of Nyanza was also visited.

In order to understand more about different semi-off site sanitation systems a lagoon of Nyarutarama was visited in that concern. It is a unique treatment plant in a new rich neiggbourhood of Nyarutararma. Field trips were performed in other semi-off sanitation facility for CSR Gacuriro in Gasabo district.

As mentioned above, another technique used during data collection period was field observation. This was used to get information on technical part of existing sanitation systems in the area of study, such as drainage and sewer systems, sanitation systems at households and the state of pollution down streams as well as difficulties faced by communities in coping with inadequate water and sanitation services in their neighborhoods.

A number of households sanitation facilities were observed during the field survey accompanied with household interviews. This was conducted in poor, unplanned, and high density settlement in three sectors of Nyarugenge district ie Muhima, Nyarugenge(Rugenge) and Gitega. The approach of interview was done through informal conversations with the household members. The concerns of the interviews that are essential to the thesis imitated the concern of questionnaires and included: utilities and services available to the household; cultural and social factors affecting sanitary and hygienic practices, proposal on improved sanitation facilities, health conditions of the household members and conditions of the house. Additional information was based on the self-observations and insights.

3.1.3 Questionnaires for households

Further primary data were obtained through a survey using closed-ended structured questionnaires. A total of two hundred (200) households were systematically sampled. The concerns of the questionnaires that are essential to the research included: utilities and services available to the household; cultural and social factors affecting sanitary and hygienic practices, proposal on improved sanitation facilities, health conditions of the household members and conditions of the house. Utilities and services available to the household include water supply, the type of toilet and means of waste disposal, bathing, washing and laundry facilities and the garbage disposal method. Cultural and social factors affecting sanitary and hygienic practices include the anal cleaning material used, the attitude on waste-handling, and acceptability of communal toilet and privacy requirements.

3.1.4 Desk study

To complement primary data from the field survey, interviews and field observations, secondary data was acquired with the help of existing literature and both government and non government official documents.

The water and sanitation sector being a cross-sectorial domain, there are many intervening parties such as state institutions, international organisms, NGOs, civil society and private sector. Their implication is indispensable particularly in the identification of requirements and program definition, resources mobilization,

execution, monitoring and program assessments. Among ministerial institutions of Rwanda, the major partners are MINECOFIN, MINITERE, MINAGRI, MININFRA, MINISANTE, MINEDUC and MINALOC. Related reports and a good number of other relevant documents were therefore accessed and reviewed from both mentioned public and private sources. Other relevant information resources are different libraries, modules handout, books Internet and UN reports national wide about the sanitation sector progress. These documents were used to identify different sanitation related policies and strategies, legal framework, the institutional set up and the financing of the sanitation sub-sector.

3.1.5 Analysis of data

This task involved the analysis of sanitation conditions in the case study. An analytical framework for analyzing the provision of sanitation services was then developed based on desktop-study and household interviews with key informants. Qualitatively and quantitatively data were transcribed, edited and categorized in order to produce systematic sound results. Qualitative data was transformed into quantitative data of Microsoft Excel. Graphs and tables were produced to present the results.

CHAPTER FOUR

RESEARCH FINDINGS AND DISCUSSIONS

The case study analyzes the existing sanitation systems in the City of Kigali in order to determine essential factors for the improvement of sanitation systems for the community. This chapter discusses the technical feasibility and acceptability of improved sanitation systems considering socio-economic issues and describes the management structure of sanitation sector by analyzing existing policies, laws and institutional framework of the sector. Other sanitation issues are considered accordingly to give a clearer picture of the problems. The study is based on the results of the field survey, questionnaires and desk study.

4.1 The management structure for the provision of sanitation services in the City of Kigali

4.1.1 Policies and strategies for Water and Sanitation sector

4.1.1.1 Policies

The study found that generally there is a good will by f the government to form new policies and strategies. Rwanda started water and sanitation sector reform based on decentralization policy elaborated in 2001. That is why, water and sanitation, health and hygiene promotion policies are in place. It was observed that existing water and

sanitation, health and hygiene promotion related policies are still new and not well known at the decentralized level. Moreover, different strategies, including the draft of strategy of sanitation and promotion of hygiene, have been elaborated to guide the implementation process of those policies.

Based on environmental policy, the new sectoral water and sanitation policy has been elaborated in 2004. It is a new policy after water and sanitation policy developed in 1992, revised in 1997 and in 2001. The government took the initiative of formulating a new policy based on decentralization policy, Rwanda vision 2020 as well as Millennium Development Goals (MDGs). The sectoral water and sanitation policy elaborated in 2004, highlights that water and sanitation sector is facing various problems like insufficient sanitation infrastructure, lack of local expertise in terms of water resources management, lack of database for water resources and sanitation situation in the country, as well as limited participation of private sector in water resources management and sanitation. The overall objective of the policy is to improve the living conditions of the population through optimal use of water resources and access for all to water and sanitation services. Recent elaborated sanitation and hygiene promotion related policies are shown in the Table 4.2 below.

Table 4.2: Policies related to sanitation and hygiene promotion

SN	Policy	Responsible Ministry	Date of elaboration
1	Decentralization Policy	MINALOC	2001
2	National Community Policy	MINALOC	2001
3	Environmental Policy	MINITERE	2003
4	Sectoral Water and Sanitation Policy	MINITERE	2004
5	Health Sector Policy	MINISANTE	2005
6	Environmental Health Policy	MINISANTE	2006
7	Behaviour Change Communication Policy	MINISANTE	2006
8	Community Health Policy	MINISANTE	2007
9	National Health Policy in Schools	MINEDUC	

4.1.1.2 Strategies

- **National strategy on sanitation and promotion of hygiene**

Rwanda has elaborated a draft of national strategy on sanitation and promotion of hygiene to guide the implementation of water and sanitation policy. The main objective of the strategy is to improve living conditions of the population through a better access to sanitation services. The strategy put emphasis on definition of standards and norms, development of adequate and appropriate sanitation infrastructures and the initiation of behavior change towards good practice of hygiene.

- **National Investment Strategy**

The 2002 National Investment Strategy encourages the private sector to participate in the provision of water and sanitation systems in rural and urban areas at affordable

prices for the citizen. It states that the state will continue to play a leading role in the development of water and sanitation sector through the provision of the necessary infrastructure.

- **Rwanda Vision 2020**

The Vision 2020 is a long term strategy which spells the countries' development agenda and policies. It sets goals that should be achieved in 20 years, with the year 2000 taken as a baseline. Vision 2020 provides clear objectives which are based on how Rwandans envisions themselves as socially and economically stronger nation in the year 2020. In regard to water the vision is that by the year 2020, all the population of Rwanda will have access to safe drinking water, and sets the increase rate of 2.5% per annum from 52% which was the accessibility in the year 2000. Concerning sanitation, Vision 2020 recognizes poor sanitation systems as a cause pollution of water resources, the environment and human diseases. It sets goals that "by 2020, the rural and urban areas are to have sufficient sewerage and disposal systems. Each town is to be endowed with an adequate unit for treating and compressing solid waste for disposal". What can be seen here is that there is no base line data for sanitation, just as it is for all other water and sanitation policy documents.

- **The Economic Development and Poverty Reduction Strategy (EDPRS)**

The latest version of EDPRS runs from the year 2008 to 2012. The document consists of principle actions and goals which form the basis for all the strategies aimed at

developing the country. In regard to water and sanitation, EDPRS is the only document which sets up goals and indicates the progress made so far compared 1990, a baseline year for MDG for sustainable development. However there is no consistency in its database in water and sanitation sector, because the data presented in EDPRS don't match with the data in the first version named PRSP, and National Water and Sanitation policy. It was also observed that PRSP and its predecessor EDPRS lacks strategies for sanitation which will help to achieve the set goals.

4.1.2 Legal framework

On the side of legal framework, new Rwandan constitution of 2003 as well as the Organic Law of April 2005 determining the modalities of protection, conservation and promotion of environment, underscores the right of the citizen to good living environment. They both underline obligations of the state and individual citizen to protect the environment. The legislation of hygiene and sanitation is still under the organic law for environmental protection. It provides general guidelines of hygiene promotion, excreta disposal, collection and sanitary disposal of septic sludge, wastewater treatment, collection and sanitary disposal of solid wastes, control of pollution in hydrographical basins as well as reuse of produced wastes within the country. It also has preventive and punitive provisions for those who pollute and destroy the environment.

Rwandan constitution clearly states in its 49th article that, every citizen have the right to a healthy and satisfying environment. The same article continues stating that every person have the duty to protect, safeguard and promote the environment, and that, the state shall protect the environment. Some articles in organic law specifically target waste management. Article 81 (part 1) prohibits any dumping or disposal of any solid, liquid waste or hazardous gaseous substances in a stream, river, lake and in the surroundings. Same article (part 2) continues by stating that it is prohibited to damage the quality of air, the surface or underground water. Another preventive provision related to sanitation is found in article 83 and 84. In these two articles, it is stated clearly that it is prohibited to dump in wetlands. Article 83 (part 1 and 2) continues to state that it is prohibited to discharge wastewater or hazardous waste in wetlands, except after treatment in accordance with instructions that govern it, and that any activity that may damage the quality of water is prohibited. Article 84 prohibits keeping or any dumping of waste which may encourage the breeding of diseases carriers and which may disrupt the people and the property.

Observations:

The observations during field trips are that the above laws are not enforced. Firstly, the reasons that the law for environmental protection is not enforced is that , it is itself new, and secondly, Rwanda Environment Management Authority (REMA) which was established in 2005 to enforce the law is also still young with few staff who are themselves new to the task of enforcing environmental standards. Another problem is

that, REMA have not published standards and guidelines for discharging wastewater in the environment, which means, they do not have legal instruments for law enforcement. In June 2007, a ministerial decree was passed by the cabinet which appointed REMA senior employees and those working in the department of compliance and enforcement to the rank of public prosecutor, as stipulated by Organic law for the protection of the environment, so that they can have legal jurisdiction to enforce the law.

4.1.3 Institution framework for sanitation Sub-sector

Institutional framework was reviewed in two different domains ie Excreta Disposal, Septic Sludge Management and Domestic Wastewater Management and Hygiene Promotion and Health Education. Different actors in water and sanitation at national level as well as at district level are identified, as shown in the Table 4.3. Their roles and responsibilities and their involvement can be found in table below. In regards to institutional framework for water and sanitation, at national level, water supply and sanitation remains to be under the Ministry of Natural Resources (MINITERE), while districts are owners and managers of municipal sanitation systems. A district also plays the role of monitoring and compliance of domestic sanitation systems, but the management remains to be the responsibility of individual institutions and households.

Line ministries and other actors in sanitation are presented in the table below. Identification of responsibilities and involvement of the influence of stakeholders was made by personal judgment, basing on the information gathered during field work and

knowledge obtained about integrated way of managing water resources and especially from my specialization in water for people.

Table 4.3: Stakeholders' analysis for Sanitation Sub-Sector

Institution	Roles and specific responsibilities (Responsible)	Involved as a key player in
☑ ***Excreta Disposal; Septic Sludge Management; Domestic Wastewater Management*** ☑ ***Hygiene Promotion and Health Education***		
MINITERE	-Development of policies and strategies -The development of sanitation and hygiene promotion related regulations. -Mobilizing funds for the sector. -Organize activities of WSS. -Planning of water and sanitation projects -Funding of water and sanitation projects using governments funds, but also bilateral and multilateral donors funds	- Implementation of projects - O&M management - involved and informed about the progress towards the achievement of national goals
MINISANTE	-Development of policies and strategies -The development of related regulations.	-To put in place health/hygiene standards and regulations for water and sanitation -Ensures compliancy in hygiene standards, through its department of inspection
MINEDUC	-Development of policies and strategies in relation to health education. -The development of related regulations in related to hygiene and health education	
MININFRA	-Implementation of investment and labour intensive water and sanitation projects as infrastructures are concerned	- Contribute in sanitation related policy making process

MINECOFIN	-Financing of MINITERE budget Harmonizes external finances -Participates in the determination of tariffs -Supervises Institutional reforms	- Contribute in sanitation related policy making process
MINALOC	-Ensure good governance in all local administration levels -Playing an intermediary role in channeling funds for development sanitation projects based on the priorities of districts.	-Involved in sanitation related policy making process
MIGEPROF	-	-Involved in formulation of policies which are gender sensitive
REMA	-To set up environment standards and regulations -Monitoring and compliance -Environmental awareness -Together with other regulatory agencies, users committees and users is also concerned with supervision/oversight to ensure effective management of wastes.	
RURA	-To ensure services are provided according to required standards -To ensure there is good conditions for fair completion in provision of public services -To ensure supervision of sanitation projects	-To watch over the results of effective implementation of sanitation and regulations.
RBS	-To ensure competitive products of the country -To ensure supervision of sanitation projects	-To watch over the results of effective implementation of sanitation and regulations.
ELECTROGAZ	-To distribute water and electricity -Implementation of water projects	
Local Government (Kigali City council, Districts and sectors / (imirenge)	-Implementation sanitation of projects -O&M and management of waste -Oversight -Districts are responsible for mobilization of programmes of hygiene promotion and health	

	education	
	-Users committees and users are also concerned with supervision to ensure effective management of solid wastes.	
Private sector	-Participate in implementation sector projects -Responsible of O & M	-To participate in policy making process -To comply with the set standards and regulation
NGO's		-To provide water and sanitation facilities, especially to the poor -To provide technical support -Advice in policy making
User committees and users ie sectors/imirenge and the community	-Oversight/supervision -User committees are responsible of hygiene programmes' mobilizations -To comply with the set standards and regulation	-Beneficiary of water and sanitation projects -Participate in policy making process

Source: Author, with the help of interviews

General critical aspects:

It is important to have institutional framework to solve environmental problems, but on the other, establishing institution alone can not be enough to address sanitation problems when there are no qualified staff to deal with technical issues such as preparation and interpretation of legal and policy instruments. Expertise at all level as structured under decentralization set up is still a challenge.

The mechanism of regulation is under the responsibility of three regulation agencies ie REMA, RURA and RBS. REMA is in charge of environmental regulations, pollution prevention monitoring and evaluation of the implementation of environmental policy

and organic of environmental protection. RURA is Rwanda Utilities Regulatory agencies where all services delivered by utilities have to be watched over whereas Rwanda bureau of Standards (RBS) is in charge of harmonizing standards from different institutions. The study found that the coordination mechanism and harmonization of their activities are still week.

The country put emphasis on formulating new policies and strategies. Lack of sectoral laws and standards are the barrier to achieve sustainable wastes management within the county and are main constraint to the implementation of policies and strategies elaborated in relation to sanitation. Hygiene promotion and health education are the key elements to achieve adequate sanitation. To this end, hygiene promotion program should be in line with any water and sanitation program. Only HAMS in schools were found successful. Other hygiene and heath education such as PHAST and WASH are not showing up their impact in Kigali community.

4.2 Financing of sanitation sub-sector

On national level, water and sanitation are handed in one unit and are financed by money from recurrent as well as development budget of MINITERE, under its Water and Sanitation unit. Recurrent budget covers day to day activities and salaries of sector employees and comes from internal revenues, while much of the money for development budget is provided by external donors, and is spent for water and

sanitation infrastructure development as well as water resource management. There are other Ministries such as MINISANTE, and MINEDUC, which also tend to finance their own water and sanitation projects for example, sanitation for schools, hospitals, or water supply for farmers, etc., which according to the director of water and sanitation in MINITERE need to be harmonized so that the sector can pursue good data management on the development of the sector. The Table 4.4 below provides expenditure trends on water and sanitation from different sources in the country.

Table 4.4: Water and Sanitation resource flow expenditure in millions (RWF) 2003-2005

	2003		2004		2005	
	Planned	**Actual**	**Planned**	**Actual**	**Planned**	**Actual**
National budget	1882	2676	2965	3167	7699	8357
MINITERE	145	81	669	565	3246	3408
Electrogaz	1716	1784	2288	2288	3396	3396
Reccurent budget	886	886	1809	1809	2790	2790
Development budget	830	898	479	479	606	606
MINAGRI	0	0	0	0	124	120
MINISANTE	21	267	8	7	7	7
MINALOC	0	544	8	307	26	1426
Province	0	0	0	0	26	18
CDF	0	544	0	235	0	1325
HIMO	0	0	0	72	0	83
External financing	5422	2733	10548	4181	14988	11447
Project	5422	2477	10548	3781	14988	10737
NGOs'	0	256	0	300	0	710
Total resources	7304	5409	13513	7248	21787	19804

Source: GoR Budget, ELECTROGAZ and NGOs; Cited in Water and sanitation sector performance 2006.

The majority of financial resources that fund the sector is provided by external donors, which in 2005, accounted for 58% of the total resource flow to the sector, at the same time, the contribution of external donors to the disbursement of water and sanitation sector has more than tripled from 2003 to 2005.

According to different documents, water and sanitation sector operates under four sub-programs, named Management support which is responsible for among other things human resource capacity building, water resource management, portable water and sanitation. The Table 4.5 below indicates what was allocated to each sub program between the years 2003 to 2005.

Table 4.5: Sector expenditure by sub-program (million RwF) 2003 - 2005

	2003		**2004**		**2005**	
Sub - program	Planned	Actual	Planned	Actual	Planned	Actual
Management support	95	54	76	49	31	12
Sanitation	485	536	1779	262	2767	1349
Portable water	6589	4795	11082	6902	18456	18167
Water resource management	138	24	576	36	533	276
Total	7307	5409	13513	7249	21787	19804

Source: water and sanitation sector performance indicator 2006

From the above table, it can be observed that portable water had the biggest portion of disbursed funds, compared to other sub-programs, which accounted for 92% of the total

sector expenditure in 2005, with sanitation accounting for only 7%. This means that little funds were left to be allocated to fund sanitation projects; and this just shows disparity in prioritization between the two sub-programs.

For the year 2006, 2007 and 2008, the development budgets denote huge dependence on external financing of the sector, 73.9 % and 62.4% respectively. Table 4.6 and Table 4.7 show how water and sanitation is budgeted for the years 2006 to 2008.

Table 4.6: Water and sanitation program and sub-program budget, fiscal year 2006 and 2007

Program	Sub program - 2006	Budget 2006 (in million Rwf)	Sub program - 2007	Budget 2007 (in million Rwf)
Water and Sanitation	**-**	**9 692 580 091**	**-**	**22 517 260 225**
	Sanitation	5 452 406 296	Implementation of the water and sanitation policy	5 115 540 448
	Water sector	396 233 304	Hydraulics	217 000 000
	Integrated management of water resources	172 500 000	Management of Water Resources	650 304 025
	Potable water infrastructure	3 671 440 491	Sanitation	16 534 415 752

Source: Author, extracted from the National budgets 2006 and 2007

Table4. 7: State expenditure per Budget Agency, water and Sanitation programs and sub-programs 2008

Program	Sub program	Budget for 2008 Recurrent	Budget for 2008 Development	
			domestically financed	external financed
Water and Sanitation		**575 281 041**	**9 957 697 400**	**14 599 453 148**
	Legal, Policy, Regulatory and Institutional framework for water	150 000 000	0	0
	Management of Water Resources	154 200 000	93 000 000	704 155 080
	Access to water for economic purposes	14 800 000	0	0
	Transfer to the water agency	256 281 041	0	0
	Access to drinking water and sanitation	0	9 864 697 400	13 895 298 068

Source: Author, extracted from the National budgets 2008

The principle bilateral donors that support water and sanitation sectors in Rwanda are Germany, Austria, Belgium and Japan. Key multilateral donors include the World Bank, FIDA, ADB, ABEDA, UNICEF and EU.

4.2.1 Financing of sanitation systems at District level

Financing of water and sanitation systems at district same to national level is guided by Rwandan Vision 2020 and EDPRS directives for sustainable development. The financing of water and sanitation like other development projects at district level is

guided by Medium Term Expenditure Framework (MTEF) budget. The MTEF shows how funds in the coming three years will be used to generate the required outputs. The annual budget performs a similar function over a one year period. Arriving at a realistic MTEF and annual budget requires strong procurement planning. The MTEF and Annual Budgets serve as the basis from which ministries, districts, and other spending agencies derive annual work plans; first for each unit, and subsequently for each individual staff member working in that unit.

From the year 2006, management of sanitation systems has been devolved to district councils from Regions and City council for Kigali. This delegation was preceded by fiscal decentralization, so the funds which used to be provided by the government to the city council for sanitation infrastructure development are now given to district councils. The money for district projects from the government budget is channeled through district's CDF which has its head office in MINITERE. Nyarugenge CDF, like other districts submits their projects and budgets to CDF head office in MINITERE who examines projects and provides money to finance districts projects. The Table 4.8 below show how MTEF development budget is structured in Nyarugenge District.

Table 4.8: MTEF Development budget for Infrastructure Development in Nyarugenge district in Rwf (2007-2009)

Projects	2007	2008	2009	Total
Roads maintenance and construction	2,125,769,200	2,404,000,000	4,098,000,000	8,627,769,200
Construction of offices and other public buildings	734,475,000	240,000,000	750,000,000	1,724,475,000
Construction of portable water infrastructure	87,247,600	0	0	87,247,600
Construction of runoff water drainage systems	86,000,000	147,000,000	317,000,000	550,000,000
Sanitation infrastructure	0	100,000	1,200,000,000	1,200,100,000
Total				12,189,491,800

Source: Extracted from Nyarugenge MTEF Development budget for 2007-2009

In the table above it can be seen that in 2007, there is money planned for portable water project, besides that water supply is not a responsibility of the district. This is because there are new adopted administrative sectors which were previously part of Kigali rural, and which do not have portable water infrastructure from ELECTROGAZ, which at the moment has no plans to invest in the area. The money amounting to over 158,000US Dollars (87 million RwF) have been planned to construct bore-holes for people living in those former rural sectors.

As can be seen, there is no money allocated for sanitation for the year 2007, and almost in 2008, but, there is 2.2million US Dollars (1.2 billion RwF) proposed for two

domestic sewage treatment plants to save the City centre / Muhima, and Gitega/Nyamirambo in 2009. In regard to the amount of money planned for sanitation in comparison to other construction projects, the above table indicates that substantial amount of money is planned for construction of Roads, which accounts for 70% of all the funds planned for infrastructure development from 2007 to 2009, followed by construction of public houses like markets and offices, while the funds designated for sanitation are less than 10% in the same period.

Regarding the financing of domestic, institutional and industrial sanitation systems, it is obvious that since there is no centralized sewer system in Kigali, individual households, institutions, businesses and industries are responsible in construction and maintenance of their sanitation systems. In general, households with financial power will own a septic tank, because it more hygienic but require enough water supply and more money to construct than traditional pit latrine which are owned by those who are not financially powerful. The cost of construction of a complete automatic flushing toilet with a septic tank in Kigali can be in a range of 1,500 to 3,000US dollars, which is a lot of money for a common resident, while a tradition pit latrine can be around 180-350US dollars, depending on the material used on the supper structure. The cost of a pit latrine has dramatically risen in recent years because of the government’s new law, which ban unauthorized cutting of trees, even if you have a forest farm. This has also resulted in high prices of burned bricks.

4.2.2 General challenges

The main challenges of sanitation sub-sector in terms of financing can be classified under two main categories, which are financing mechanism and competing priorities and needs. Sanitation sub-sector is always left behind in terms of setting priorities and financing comparing to potable water supply.

Actually, sanitation is an individual business and financing is only regarding public sanitation infrastructures and sanitation facilities for vulnerable groups. But, Table 4.9 below shows that the investment planning in sanitation to meet sanitation MDG is not sufficient comparing to the total public investment requirement.

Table 4.9: Investment Requirements to Meet Sanitation National target and MDG in Rwanda

	Years of Refence			Planning of Investments	
	2000	2005	2015		
Location	Access Rate (%)	Access Rate (%)	Access Rate (%)	Total Investment Required (US$ M/Year)	Public Investment Planned (US$M/Year)
Rural	8	38	65	5	1
Urban	8	56	65	5	0
Total	8	42	65	10	1

Source: Adapted from RoR (2006d) and WSP, et al, 2006[9]

The total investment required is estimated to be US$10 millions each year in both rural and urban areas. But, only one million USD is planned each year for only rural area. The sanitation financial planning of urban area will depend upon the master plans of

city and towns under development. Therefore, it is necessary to review financing mechanism and planning to make sure that national sanitation goal and MDG are met by 2020 and 2015 respectively.

4.3 Existing sanitation systems in the City of Kigali

Existing sanitation facilities in the Kigali City community are categorized as either communal toilet facilities provided by the local government and individual and private toilets built by the people themselves. Though, these facilities are available, they do not guarantee the safe disposal of the excreta. Problems associated with the existing sanitation facilities are discussed below.

4.3.1 On-site sanitation systems

Apart from those three mentioned small estates, the rest of Kigali city, including Nyarugenge district where the city centre is located, decentralized, on-site systems sanitation, are the only ones in existence. In general the type of sanitation system in the households depends on the financial status of the owners and people who are financially powerful possess water automatic flashing toilets connected to septic tanks. It was observed during field trips in Nyarugenge district that, in the city centre and affluent neighborhood of Kiyovu, the type of sanitation systems and toilets in use were septic tanks with soak pits. This type of sanitation system was found to be dominant in the above mentioned areas because its construction requires a lot of money and water to

transport wastewater and excreta to a septic tank. Septic tanks with soak away pit latrines are water based sanitation systems and when there is adequate water supply, they provide the same comfort as Centralized Sanitation systems. It was also observed that in some of the houses which had septic tanks with soak away pits, they also had traditional pit latrines. This trend was found in both households and small low cost restaurants and the reason for having two types of toilets was explain to be a back-up in case there would be no water supply from ELECTROGAZ.

Note that the identification of available sanitation systems in the city of Kigali was facilitated by the use of survey questionnaire per household which covered different issues such as utilities and services available and their accessibility to the household; cultural and social factors affecting sanitary lives; hygienic practices; their opinion on the state of community sanitation infrastructure at their places in general was surveyed to determine whether they are satisfied with the current state of community sanitation systems or not; acceptability of improved sanitation systems; proposal on improved sanitation facilities as well as their participation to new improved ones.

4.3.1.1 Access to water supply

Portable water in Kigali City is supplied solely by a state owned public utility for production, transmission and distribution of electricity and water (ELECTROGAZ). Besides the capital city, the company provides electricity and portable water to all major

towns in the country, ELECTROGAZ is a semi-autonomous public company with a Director General appointed by cabinet of ministers. However principal decisions like investment, planning and development budgets are taken by sentinel ministries of MINITERE for water supply projects in its Water and Sanitation Unit and MININFRA in its Special Unit, for Electricity projects.

Findings from the questionnaire survey shows that 84% of respondents get water from electrogaz, either directly connected, buy the water from electrogaz kiosks, or buy from connected neighbors. Again 16% of respondents fetch water from other sources ie wells, running water from different places. (See Figure 4.5 below).

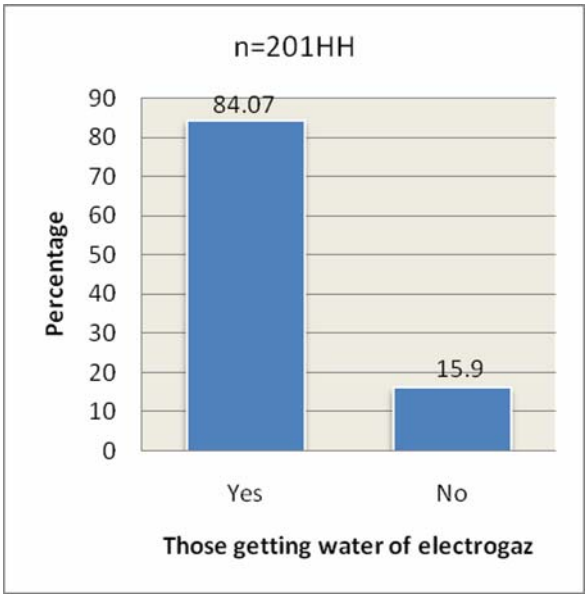

Figure 4.5: Beneficiary of electrogaz water

In addition to the above findings, the survey revealed that only 11.3% respondents e with portable water from electrogaz get above 80% of their total water requirements. 43.8% said they receive water between 60-80% of their demand, while 22.2% get just 50% of their demand and 22.8% receive below 25% of their total water requirement.

The analysis of other sources of water and those not directly connected to electrogaz was also carried out, and the results indicated that the majority, 40.6 % buy water from neighbors; 36% buy water from ELECTROGAZ water kiosks (stand pipes) at a price of 0.04 U.S dollars (20 Rwf) per 20 litres, while 11.3% fetch water from water streams around Kigali city. Only 10% of those without access said they fetch water from bore-holes or a well near the house.

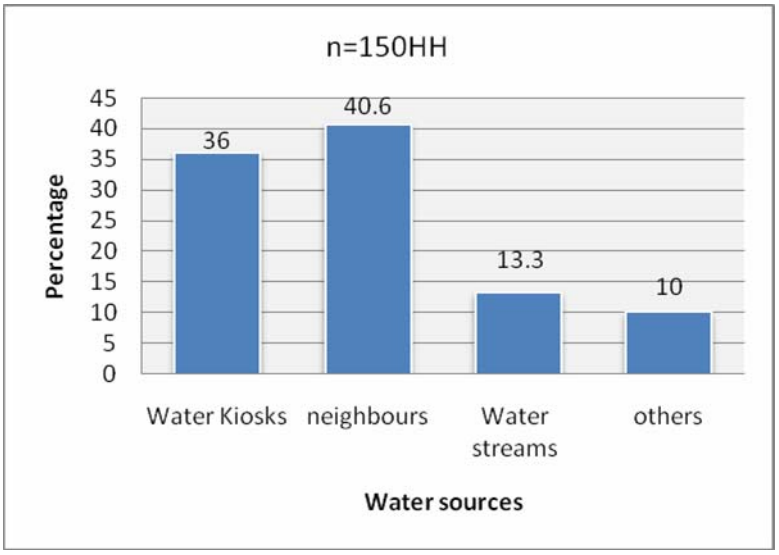

Figure 4.6: Water sources without connection from electrogaz

Remarks:

Generally, the types of water services in a given community can be hand-carried supplies, yard taps or in-house connections. These levels categorize the different sanitation options. Systems without water requirement or those requiring water only for toilet hygiene, include pit latrines, pour flush toilets, composting toilets, and their various adaptations. Those which require at least yard tap or household pump include septic tank. More expensive systems such as cistern-flush toilets with conventional sewerage or septic tanks and soakaways are technically feasible when an in-house connection is available.

In the context of the City of Kigali, as per findings, the in-house connection is limited and water is usually bought or fetched from communal water kiosks and hence, hand-carried. For the majority of the households carrying water to their homes, the distance traveled by the household member fetching the water from the water kiosks can be as far as 400 meters (maximum). Thus, options requiring individual in-house connections or a large amount of water for disposal are not easily feasible. Other systems that require no water or those in which water is used only for toilet hygiene are highly favorable.

4.3.1.2 Accessibility to and toilet facilities available in the City of Kigali

Basing on a total of 200 households that were surveyed, the analysis of results indicates that 92.7% of households have toilets and 7,2% don't have toilets at all as illustrated by the Figure 4.7 below.

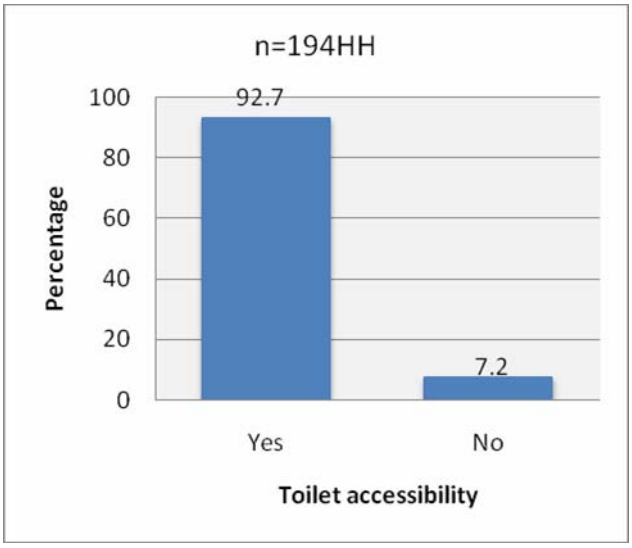

Figure 4.7: Access to toilet facility

As shown by the Figure 4.8, traditional pit latrines were found to be dominant type of toilet systems used by the majority of the respondents. The survey went further to establish that 77.3 % of the households in the study area, use traditional pit soak away latrines, while 4.4% have Ventilated Improved Pit latrines (VIP). Other technologies of excreta management that were found in the study area were Pour-flush latrines piped to soak pit and Automatic flushing toilet systems, piped to septic tanks. Households that were found to be using Pour-flush toilets connected to soak pits were 2.9% and those

who could afford automatic flushing toilet systems (water closets) piped to septic tanks were found to be 15.2 %.

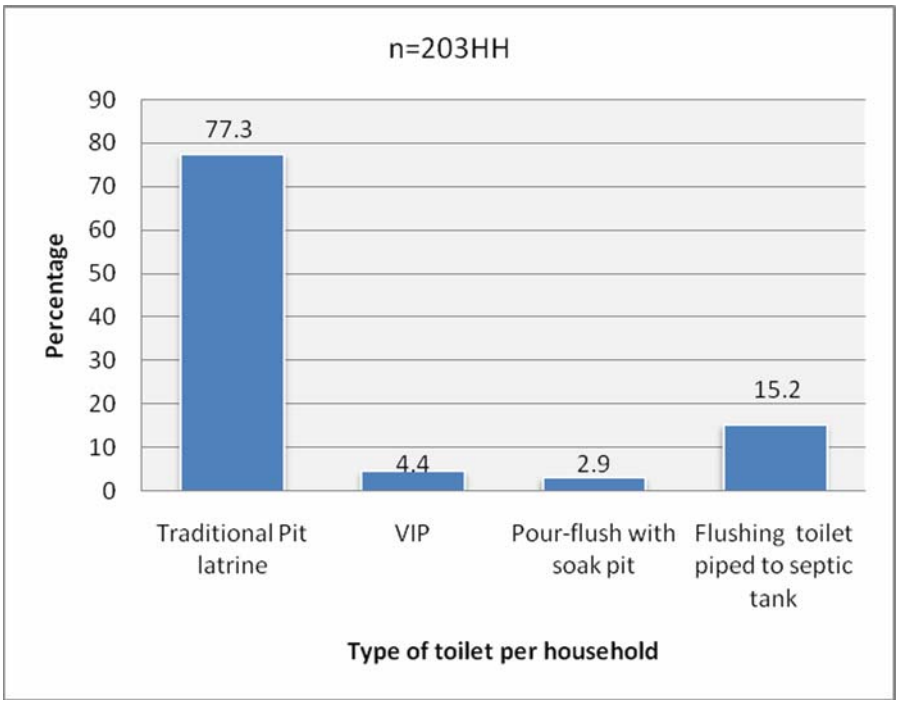

Figure 4.8: Types of toilet available

Observations:

Traditional pit latrines visited most of them were at critical status as hygiene is concerned. Some pits were not clearly covered and caused bad smelling of the toilet. A lot flies were found since there was no air circulation with toilet structure. Traditional pit latrines are low cost alternative means for toilet waste disposal which is applied widely by the low income majority in developing countries as it is the case in Kigali City. As shown by the figure 9 above 77, 3% of population of Kigali City uses traditional pit latrines.

Due to the fact that the City of Kigali has a high density (376 inhab/km2), systems such as pit latrines, aqua privies and septic tanks require adequate space for the infiltration of waste discharged into them otherwise pollute the ground water and cause danger in terms of wells for drinking water facilities which might be close together.

In high- density informal settlement of Kigali City, there is no space available to dig new pit after existing one fills up. So the option is to design them so that they can be emptied periodically. The other disadvantage for the provision of pit latrines in the Cok is that most of poor people are concentrated on too steep soil which is incompatible with pit latrines.

The CoK has a hilly topography and has ferralitic, lateritic and sandy soils. It has good soil permeability and stability of Soil permeability and stability of 0.01- 0.7 cm/min. This discourages the construction of pit latrines due to their deepness factor. But lucky enough, majority of living zones are found at the top of hills.

In the case of septic tanks, good soil permeability of the city allows to dig septic tanks with reasonable infiltration soakway pits. On the other hand, sludge is supposed to be emptied periodically by use of trucks. It was found that only 12% of septic tanks are emptied at insufficient rate. It was observed that access for empting services are limited due to the fact that there is insufficient emptying equipments such as trucks and due to lack of

access network ie roads infrastructures. The existing ones consist of almost of narrow footpaths. These cause problems of operation and maintenance of septic tanks. And it limits pollution risks.

4.3.1.3 Need and acceptability of improved sanitation facilities

According to the findings, 50.26% of households were satisfied with their individual sanitation facilities while 49.73% are not satisfied with them. 85.71% wish to have flushing toilets while 14.29 wish to have VIP toilets. (See Figure 4.9 and Figure 4.10)

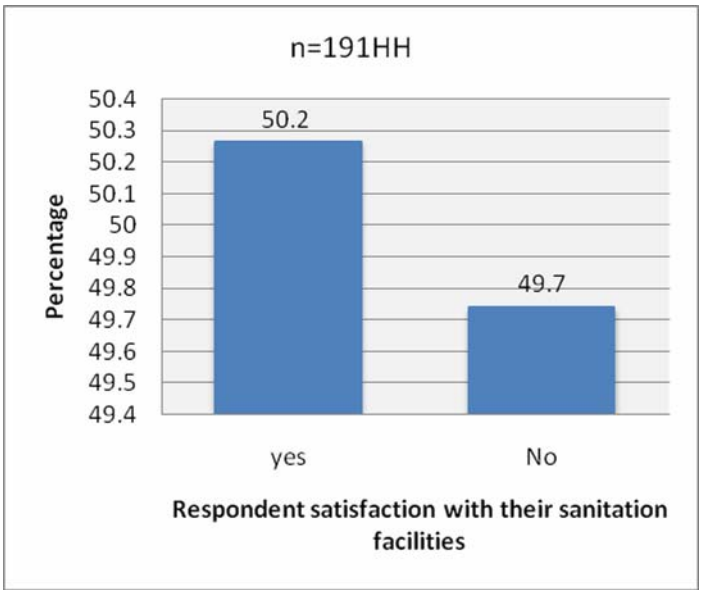

Figure 4.9: Satisfaction with the available toilet facility

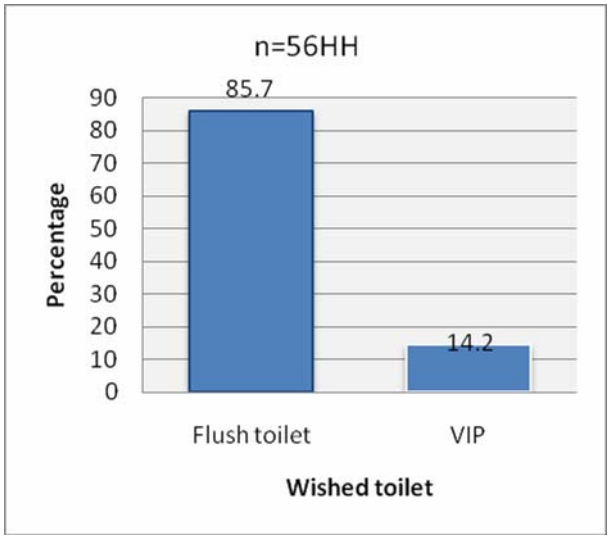

Figure 4.10: Type of toilet according to respondents' wishes

The latter finding shows the respondents acceptability of alternative sanitation facilities. It is shown by the Figure 4.11, where 95% of households will accept alternatives, 3.3% will not accept due to different reasons, while 1.7% didn't show up their position.

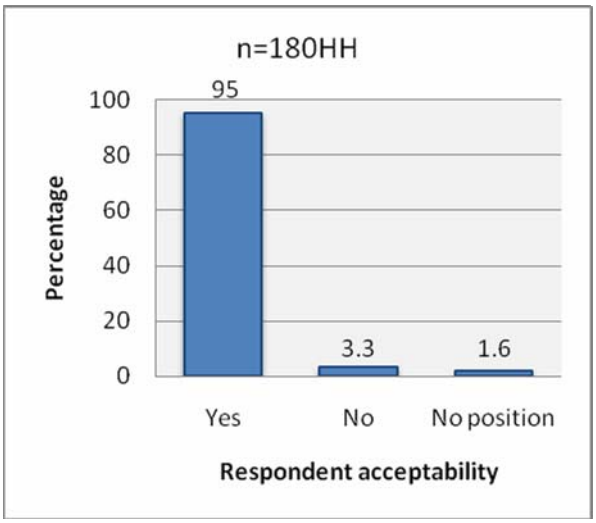

Figure 4.11: Acceptability for other options

Referring to the Figure 12 below, the respondents showed their level of acceptability by showing their willingness to participate.

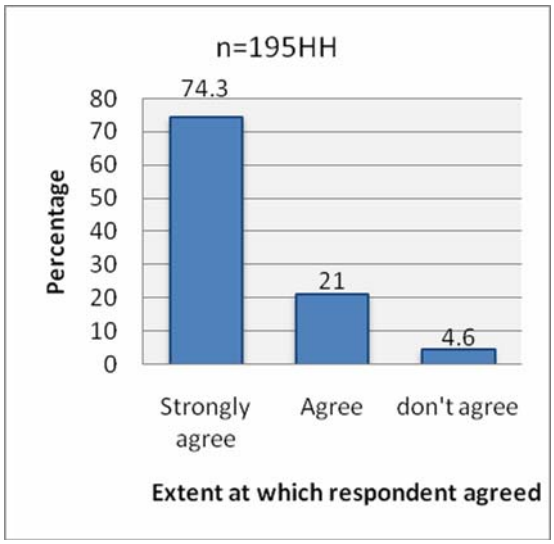

Figure 4.12: Extent of acceptability

Comments:

Recent thinking on service provision stresses that infrastructure schemes must respond to user demand by providing what potential users want and are willing to pay for. This 'demand responsive' approach has replaced the old emphasis on supplying what professionals think is good for users, regardless of whether the users want what is supplied or are willing to pay for it. While clearly an improvement on the old supply driven approach, the pure demand-responsive approach was found also inadequate in a number of respects. It is based on what intended service users know, thus limiting scope

for change and innovation and it ignores the fact that service users are likely to be concerned only with their immediate surroundings, so that demand for local improvements may be at the expense of the wider environment. Therefore, a strategic approach to service provision must consider both supply and demand. It must first establish demand for improved services, then inform it, in terms of what is possible and what is needed to bring about real change, and finally respond to the informed demand in an effective way.

4.3.1.4 Socio economic based factors and barriers to improved sanitation systems accessibility

Major factors such as cultural, economic, technological, topography and plot size are considered as barriers to improved sanitation facilities. The questionnaire survey identified that economic factor is the major factor then small plot size, cultural barriers, technological factor comes as the fourth and lastly the topography of the study area. This is shown in the Figure 4.13 below.

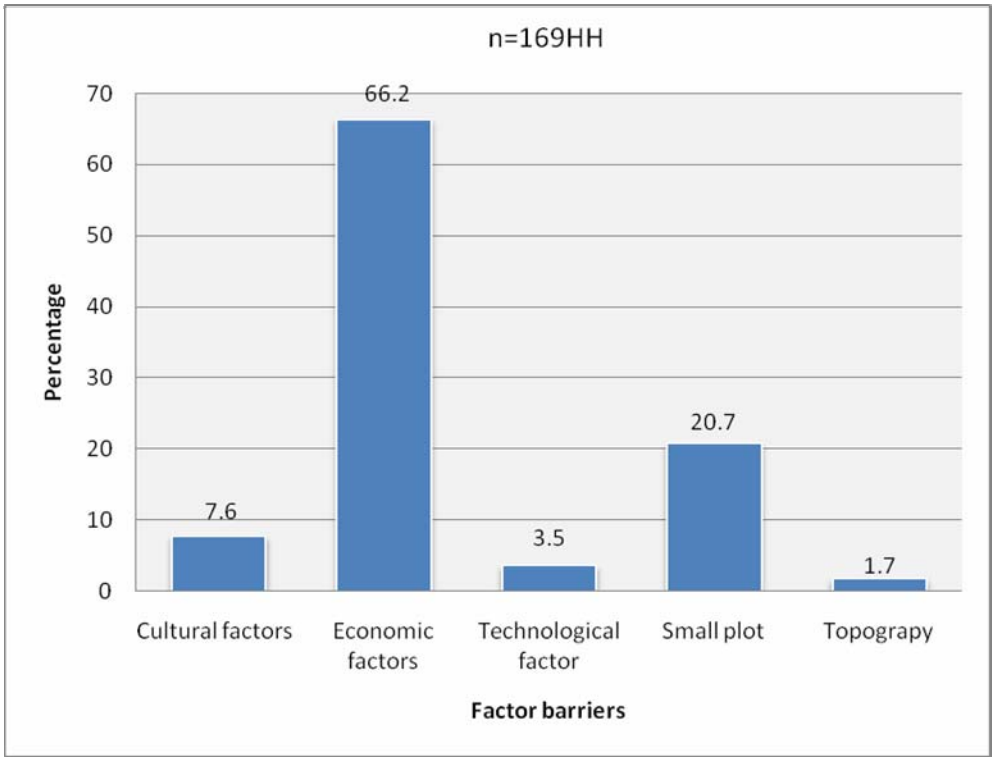

Figure 4.13: Socio-economic based barriers to improved sanitation facilities

- **Economic factor**

This is due to poverty is a strong barrier to improved sanitation facilities. Now, poverty is a phenomenon, which hits different parts of the world with varying degrees of acuteness. Even within countries, poverty affects different regions differently. In most Third World countries the majority of the population lives in dire deprivation, without access to basic services such as health, education and housing facilities. In Africa, poverty is more hard-hitting than elsewhere, particularly in sub-Saharan Africa, where governments plead constantly for economic aid from developed countries.

In Rwanda today, poverty is an urban phenomenon as much as it is a rural one. In 1985 about 40% of the total Rwandan population lived below the poverty line. During the early 1990s, diminishing agricultural productivity and the decline in international coffee prices caused a significant reduction in per capita incomes. By 1993, 53% of the population was living below the poverty line. The war and genocide, contributed to a dramatic increase in poverty, with the proportion of households below the poverty line rising from 53% to 70% between 1993 and 1997. Since then, the country has been recovering. The latest estimate of the proportion below the poverty line is 65%. (MINECOFIN, PRSP November, 2000).

In the aftermath of the genocide and associated conflicts (1996-2000), real GDP grew at over 10% per year as the economy recovered from a low base. This was followed by a period of stabilization (2001-2006) during which real growth fell to an annual rate of 6.4%. (EDPRS, 2008-2012).

- **Plot size**

The second factor identified was the plot size which is claimed to be not enough to facilitate improvement of sanitation facilities. The country natural population growth, together with the increased numbers of returnees from neighboring countries, has inevitably highlighted land administration and land use management issues as central areas of concern for the ongoing land tenure and land use management reform process. Land reform that ensures effective administration, the rights and obligations of land

users, the introduction of legal and institutional mechanisms for land use management and dispute resolution all provide scope to improve the welfare of the poor and vulnerable groups. The new Organic Law on Land, in principle, strengthens women's rights to land. The redistribution of land arising from private and state lands and pastures will likely have a positive impact on the poor. Furthermore, safeguards that provide alternative livelihood opportunities for the poor through land tenure regulation and options that encourage improved land management are being developed.

In general the proportion of households in each land size category has changed relatively little since 2000/01. Two percent of cultivating households do not own any land, so they rent, sharecrop or borrow land. Around half of cultivating households (representing 3.6 million people in 2000/01 and 4.5 million in 2005/06) cultivate less than half a hectare. More than 60% of households cultivate less than 0.7 ha of land, and more than a quarter cultivate less than 0.2 ha. The standard of living is strongly related to the size of landholding, with those holding the least land generally being the poorest. There was a reduction in proportion of landowners in the bottom consumption quintile and an increase in the highest quintile.

It is indicated in the Kigali Master Plan 2020 that there is a great discrepancy between the demand and offer of plots of land for construction of houses in CoK. Since 1997, CoK has registered 3,787 applications for plots of land and only 1,291 plots have been given out, which shows that the CoK does not have the capacity to meet even a half of

the demand for land. Within the same period, only 600 authorizations for construction have been issued for the 1,291 plots given out.

- **Social, behavioral and cultural factors**

Other major social considerations to focus on in planning improved peri-urban sanitation services center around the recipients hygiene behavior. Hygiene modifications are essentially the changes in peoples behavior that, over time, improve health. One way behavioral change is demonstrated is by the ways people use improved infrastructure. Usage and sustainability are critical to the success of sanitation projects. Unless facilities are suitable for the people using them and unless the technologies are affordable and efficient, the facilities will remain unaccepted and underused. WASH studies have shown that health benefits associated with peri-urban sanitation projects require that changes in hygiene behavior accompany infrastructure improvements (Yacoob et al. 1992).

High-risk behavior can be defined as action by men, women, and children that allows exposure to human excreta. In the City of Kigali all communities, barriers exist to changing high-risk behavior. (A barrier as used here signifies a belief, norm, attitude, or condition that either reinforces the high-risk behavior or limits the modified behavior.) Barriers may be religious, cultural, social, economic, or technological in nature and may not be readily observable. For example, a crumbling slab or a dark latrine is a condition that may cause people to fear using the latrine, or religious beliefs may dictate that

women and men cannot use the same latrine. Similarly, a community norm may allow a certain abandoned field or lot to be considered an acceptable place for children to defecate. With the cultural, social, and economic diversity common to many peri-urban areas, high-risk sanitation behaviors and barriers to changing them will likely vary widely among inhabitants. This makes surveys and other approaches to information gathering complicated and very difficult. Because of the great variation in residents, a large sample size is needed for a survey of preferences or behaviors to be useful and truly indicative of a large, diverse community. Cultural attitudes towards defecation vary but generally, it is regarded as a private personal act.

Some sanitation systems such as composting toilets ie ecosan require wastehandling and re-use of excreta. In the context of the case study, wastehandling is culturally unacceptable. It is best to dispose of the excreta right away. When asked about the potentials of waste reuse, interviewers claimed to be uninformed about the possibility. This inevitably rejects options requiring wastehandling unless sensitizations are organized in this regard.

4.3.1.5 Low Income Levels and Reliance on the Informal Economy

Families settle in informal areas for rational reasons, primarily because land prices or rents are low. A significant percentage of the population of Third World cities cannot afford the formal sectors housing, even when costs are cut to a bare minimum. The

economic crisis in many developing countries has reduced the purchasing power of low-income families and limited even further their ability to pay for formal sector housing or services. Many households in peri- urban areas do not enjoy a regular income, and large numbers of peri-urban households are headed by single women who in turn tend to have the lowest income levels of all workers. Families in rural areas are for the most part not in the cash economy. Their life is more agricultural subsistence. In contrast, in formal urban areas, most families do operate in the cash economy as workers and have access to steady jobs, pay taxes, and so on. In peri-urban areas, families are also in the cash economy but their workers rely mainly on the informal economy (for example, carpenters working out of their backyards or women selling tortillas in the market). Though poor, they nonetheless make and spend money. Because cash in the informal economy is unsteady and unreliable, residents are not deemed creditworthy and cannot get conventional bank loans.

- **Renting houses**

With the help of interviews, it was found that renting conditions are not conducive to have improved sanitation systems. Hygienic problems due to shared toilets were found to be a big challenge. The Figure 4.14 shows the status of house occupation in Kigali City.

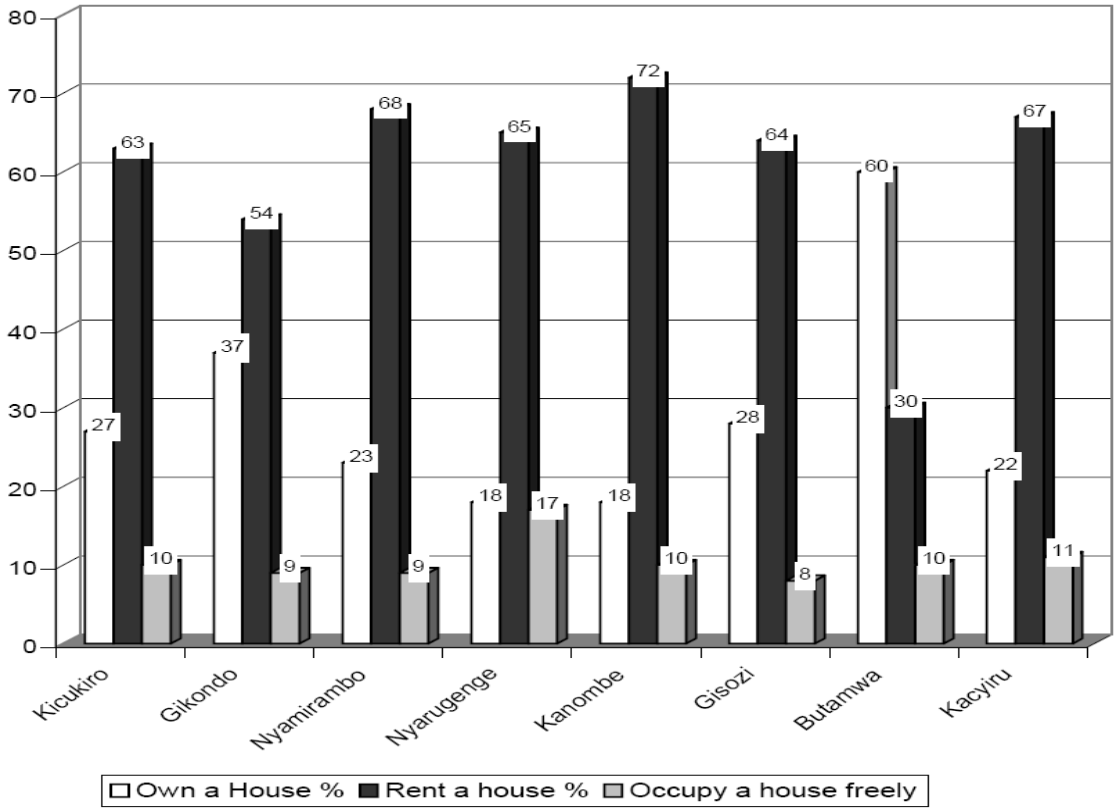

Figure 4.14: Status of house occupation in CoK

Source: Kigali Economic and Development Strategy, 2001

- **Monthly income generation and/or remuneration**

Income generation and/or remuneration may be used as the basic indicator of the welfare, and hence standards of living, of a given section of the population. It also has direct implications for the market for goods and services accessibility in the city.

Figure 4.15 below shows that 10.9% respondents earn/generate a monthly salary/income of less than 25,000 Rwf; 17% earn between 25,000 and 50,000 Rwf; 29.1% earn between 50,000 and 100,000Rwf; 8.2% earn between 100,000 and

150,000Rwf; 17.3% earning between 150,000and 200,000Rwf while 17.5% only earn over 200,000 Rwf. Taking reference to GDP in 2005 which at current prices was estimated to be RwF 1,332 billion. In the same year, the population of Rwanda was estimated at 8.8 million people. GDP per head was therefore RwF 151,000 or US$ 272 at the nominal exchange rate of 557 FRW to 1 US dollar. So the monthly income generation is still a challenge to afford improved sanitation facilities.

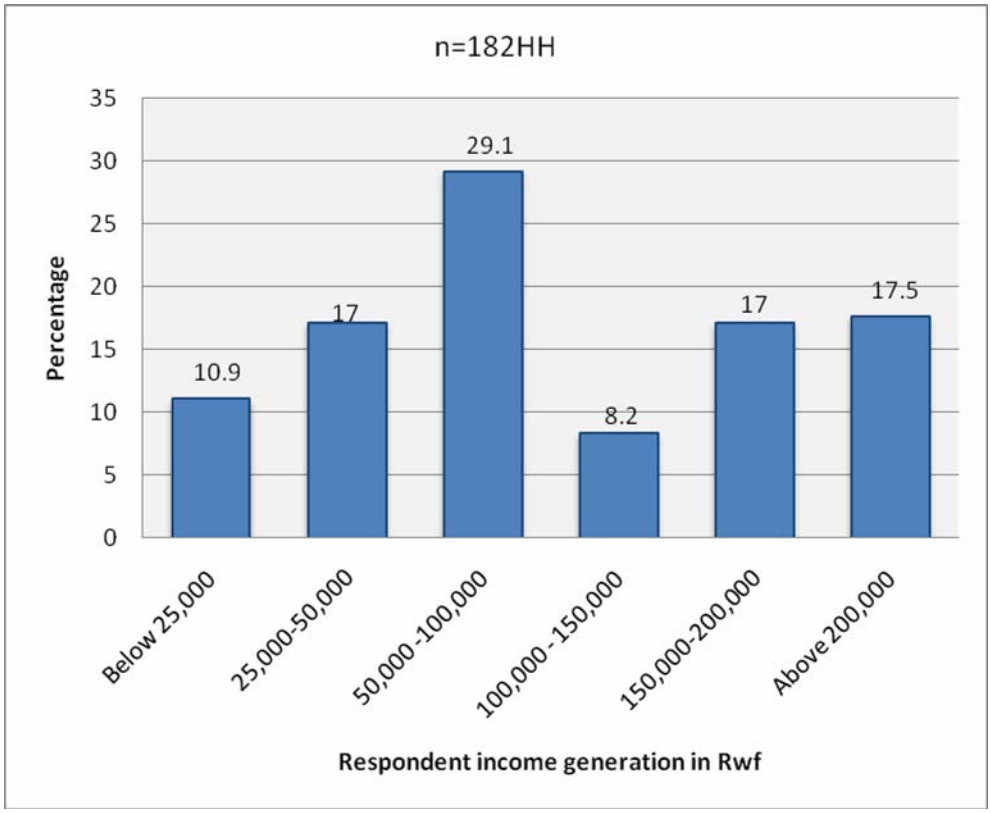

Figure 4.15: Income generation in Rwf

As a result, households with financial power will own a improved sanitation facility of their choice ie flush toilets pipe to septic tanks since it more hygienic even if requires enough water supply. The cost of construction of a complete automatic flushing toilet with a septic tank in Kigali can be in a range of 1,500 to 3,000US dollars, which is a lot of money according to households' monthly income, while a tradition pit latrine can be around 180-350US dollars, depending on the material used on the supper structure. Considering that a pit latrine has dramatically risen in recent years because of the government's new law, which ban unauthorized cutting of trees, even if you have a forest farm. This has also resulted in high prices of burned bricks.

4.3.1.6 User hygienic practices

In Kigali, public hygiene is managed by inspection unit of City Council together with the Ministry of Health. For example there is an obligation that every house should contain a toilet. But there is still a challenge with business men who decide to change resident houses into restaurants. This results in poor sanitation facilities in restaurants, since the house is of residence design. That is why inspection unit need to keep an eye to ensure adequate sanitation. Ministry of health is more responsible of awareness raising on hygienic practices. Two hygienic tools are used ie PHAST and HAMS.

HAMS Programme was brought in 2002 to light the pathway of hygiene promotion through young generation in both primary and secondary schools and health centres at district level. This program has marked with good performance where for ninety three

schools (primary and secondary) and health centres which have been evaluated by national committee of HAMS Programme, the overall performance due to HAMS Programme is 81% in primary and secondary schools as well as health centres. The primary schools performed well with 77% while secondary schools came at the last place with 65%. The health centres got 100% because they have permanent employees in charge of cleaning latrines. See Figure 4.16.

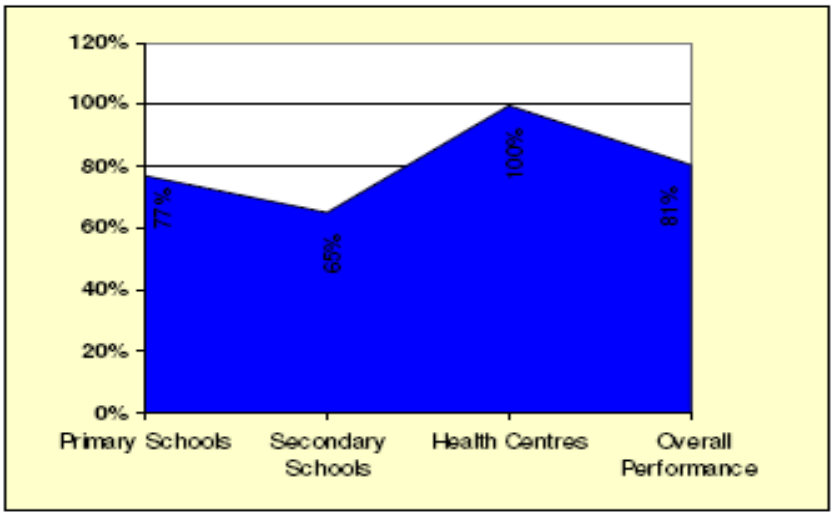

Figure 4.16: Results of HAMS Programme Evaluation in Rwanda

It was noticed that the primary schools where HAMS committees are operating, they have initiated hygiene fund via HAMS committee meetings. Above all, those schools came on top comparing to others. Therefore, HAMS Programme can be an instrument to boost hygiene promotion in Rwanda via young generation in schools. The reason behind is that every household has a child at school and the pupil can change his/her behaviour, behaviour of parents and neighbours in the direction of good practice of hygiene in their families

❖ **Cleansing materials**

The latter finding from the questionnaire survey indicates that 41.7% of respondents use toilets papers; 8.8 % use other paper; 46% use water and 2.5% use other means, as shown by the Figure 4.17.

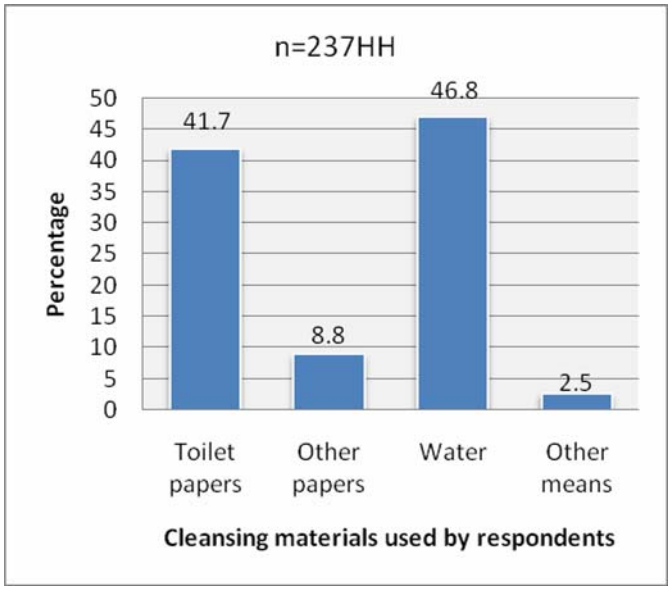

Figure 4.17: Cleansing materials

The material used for anal cleaning affects the choice of technology. When water is used for anal cleaning in pit latrines built in low-permeable soil, poor perculation and water logging occurs. In wet systems such as the pour-flush and cistern flush toilets, solid materials such as rocks, mud balls, stones and sticks cannot be used since these materials would cause blockage problems.

In the context of the CoK, water is the preferred material for anal cleaning for people with water accessibility. For those households with pit toilets, water and other papers

are used. In this case, systems which allow the use of water at least for toilet hygiene are suitable for the city.

- **Hand washing after using toilet**

The Figure 4.17 shows that 47.9% of households always wash hand after using toilet, 36.3% wash hands many times, 12.1% wash once in a while and 3.5% never wash hand after using toilet.

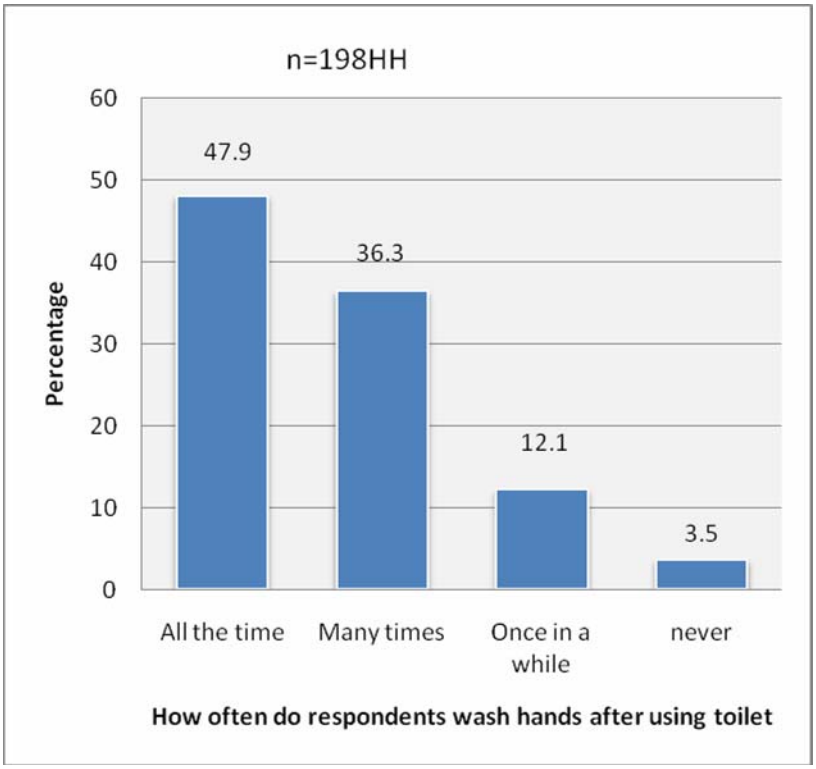

Figure 4.18: Washing hands after using toilet

Hand washing interrupts the transmission of disease agents and so can significantly reduce diarrhea and respiratory infections, as well as skin infections and trachoma. A

recent review (Curtis and Cairncross, 2003) suggests that hand washing with soap, particularly after contact with feces (post-defecation and after handling a child's stool), can reduce diarrheal incidence by 42-47 percent, while the work by Rabie et al., 2006 suggests a 30 percent reduction in respiratory infections is possible through hand washing. This remains true even in areas that are highly fecally contaminated and have poor sanitation. Another current study found that children under 15 years of age living in households that received hand washing promotion and soap had half the diarrheal rates of children living in control neighborhoods (Luby et al. 2004). Since hand washing can prevent the transmission of a variety of pathogens, it may be more effective than any single vaccine. Promoted on a wide-enough scale, hand washing with soap could be thought of as a 'do-it-yourself' vaccine. (Extracted from "The Hand Washing Handbook, WSP, BNWP and World Bank").

4.3.2 Technological sanitation systems options

4.3.2.1 VIP latrines, the best low - sanitation system option for Kigali City community

The study found that there are four types of individual sanitation systems where traditional pit latrines are dominant type of sanitation (77.7%). VIP are less used with a percentage of 4.4%, Pour flush latrines piped to soak pits were of 2.9 % while automatic flushing toilet systems piped to septic tanks were found to be 15.2 %.

- **Traditional pit latrines vis-à-vis VIP latrines**

Pit latrines are the most rudimentary form of sanitation. Structures made out of locally available materials cover a defecation hole, a pit dug in the ground to collect waste. Not entirely odor-free and there are chances of disease transmission through flies and rodents if lids are not closed after use. The latrine has to be relocated when the pit is almost full. Traditional pit latrines visited most of them were at critical status as hygiene is concerned. The open defecation hole attracted mosquitoes and flies and produces a ghastly odor. These adverse conditions lead to upgrading to improved traditional pit latrines.

Ventilated Improved Pit (VIP) latrines are an improvement over traditional latrines in two important respects: they mitigate the noxious odor and reduce the number of flies and other insects that plague users of traditional latrines. In a VIP latrine, a vent pipe allows fresh air to flow through the latrine, reducing odor. The vent also allows light into the latrine, attracting insects into the pipe, where they are trapped by the fly screen at the top of the pipe. The screen also keeps out insects looking to enter the pipe from the outside. The VIP latrine has been successfully used in different communities of African countries since the mid-1970s ie Zimbabwe, where it is known as the Blair Latrine (Robinson, 2002). This study advises the CoK to adopt VIP latrine option as they eliminate the chances of flies coming in direct contact with excreta. This prevents fly-borne transmission of fecal-oral diseases from latrines, a “major source of disease

transmission". Basic design features of VIP latrines for its effective performance are given in the Table 4.11 below.

Table 4.11: Basic design features of VIP latrines for its effective performance

	Ventilated Improved Single Pit Latrine	Ventilated Improved Double Pit Latrine
User benefits	- Almost odorless -Greatly reduced risk of excreta related and fly-borne disease transmission -Affords privacy - Aesthetically improved environment - Improved health and hygiene practice	- Almost odorless -Greatly reduced risk of excreta related and fly-borne disease transmission -Affords privacy -Aesthetically improved environment -Improved health and hygiene practice
Advantages	-Suitable for Kigali City communities using dry cleansing materials -Limited amount of water is required for occasional cleaning of squat plate -Can be built with local materials. - Low construction costs. -Simple construction and maintenance -Can be upgraded to Pour Flush Single Pit Latrine	-Suitable for Kigali City communities using dry cleansing materials. -Limited water required for occasional cleaning of squat plate. -Can be built with local materials. - Low construction costs -Simple construction and maintenance. - Can be upgraded to Pour Flush Twin-Pit Latrine -Long lasting and the digested sludge can be used as soil conditioner every 3 to 4 years -Suitable for populated areas where free space is not available for relocating latrine when it is almost full
Capital costs	Approximately 150-400 USD is required for construction of	Approximately 200 -450 USD is required for construction of this

	this latrine. (Depending on the used materials on the superstructure	latrine (depending on the used materials on the superstructure
Working life	4 to 12 years, depending on number of users and pit size	Can be used life long by using alternate pits
User's responsibility	Maintenance of vent pipe, fly screen, squat plate and superstructure	Maintenance of vent pipe, fly screen, squat plate and superstructure
Salient features	- Squat plate with two holes one for adults and one for children - Two pairs of footrests on either side of squat holes - The vent pipe should be at least 150 mm in diameter. - Outer surface of the vent pipe should be painted black, wide at the top and gradually tapering downwards.	-Squatting plate with two pair of holes, one set for adults and children (for non-using pit), another similar set of holes for pit that is under use - Two pairs of footrests on either side of squat holes - The vent pipe should be at least 150 mm in diameter - Outer surface of the vent pipe should be painted black, with wider at the top and gradually tapering downwards

Source: Author, 2008

Remark: The cost of a pit latrine has dramatically risen in recent years because of the government's new law, which ban unauthorized cutting of trees, even if you have a forest farm. This has also resulted in high prices of burned bricks.

4.3.3 Community based sanitation systems in Kigali city

4.3.3.1 Communal Toilets

The most common approach used to solve sanitation problems in Kigali City is the provision of communal toilets. This option has been considered as the only feasible and

realistic sanitation improvement in high density low-income urban areas built on tidal mudflats. In Kigali, sixteen communal toilets were identified in busy places of the city especially near bus stations and markets. Roto toilets are used by kiosks. In the provision of communal toilets, problems caused by technical requirements and socio-cultural unacceptability of the facility were met. In several cases, poor maintenance resulted in the facilities even though a small amount is paid for it. The Table 4.11 and Table 4.12 below show identified public toilet of the CoK and sanitation systems used by big institutions of the City respectively.

Table 4.11: Public toilets in Kigali City

SN	Cell	Location
1	Muhima	Nyabugogo bus station
2	Muhima	Nyabugogo market
3	Nyarugenge	Near central prison
4	Nyarugenge	CHUK, Hospital
5	Nyarugenge	Volcano buses
6	Nyarugenge	Nyarugenge market (under construction)
7	Nyarugenge	Nyarugenge bus station
8	Kacyiru	Kacyiru market – Kabagari
9	Gisozi	Art and craft market
10	Nyamirambo	Nyamirambo market
11	Kimisagara	Kimisagara market
12	Gikondo	Gikondo market
13	Kicukiro	Kicukiro centre market
14	Kicukiro	Market of zinnia
15	Remera	Bus station of Giporoso
16	Kimironko	Kimironko market

Source: Author,2008

Table 4.12: Domestic sanitation systems for big institutions in Kigali City

SN	Institution	Type of treatment
	Hotels	
1	Hotels des Milles Collines	Activated Sludge
2	Hotel Novotel	Activated Sludge
3	Serena hotel	Bio Disc
	Banks	
4	Bank of Kigali (Banque de Kigali)	Activated Sludge
5	BNR (Rwanda National Bank)	Activated Sludge
	Hospitals	
6	Hopital King Faycal	Activated Sludge
7	CHUK	Activated Sludge
8	Muhima Hospital	Septic tanks
	Others	
9	Military Camp (Camp militaire)	Septic tanks
10	Kacyiru Police	Septic tanks
11	Prison 1930	Septic tanks and lagoon
12	Prison Kimironko	Biogaz

Source: Field data, 2008

4.3.3.2 Semi off – site Sanitation systems

Kigali city unlike other cities in developing countries and regionalwise does not have a centralized sewer system for collection, transportation, treatment and disposal of domestic and institutional wastewater. However, there are three new estates in Kacukiro district with a small network of sewer pipes connected to treatment plants.

Two of the three are owned by Social Security Fund of Rwanda (SSFR), one in Kakiru area (here under referred to as Kakiru SSFR plant), and another in Nyarutarama Vision 2020 estate (to be referred to as Vision 2020 plant). The third is also in Nyarutarama area, and its treatment facility belongs to Nyarutarama Property Development Association, which built most of the houses in the area.

- **The Kakiru SSFR treatment plant**

Kakiru SSFR plant is the oldest of the three, and has been in existence for more than 15 years. About 100 houses are connected with a small network of sewage pipes to an aerobic treatment plant which uses an activated sludge process. The sewage is passed through a screen, grit chamber, primary sedimentation, activated sludge process, secondary sedimentation and disinfection. There are complains from people living downstream due to bad smell, and poor quality of effluent from the treatment plant. A plant technician cited poor aeration and sometimes electrical motor failure as prime causes of bad smell at the plant.

- **Vision 2020 treatment plant**

The second and the largest sewer network is found at Vision 2020 estate in Nyarutarama. Vision 2020 plant serves 300 houses, estimated to house about 2100 people. The plant is underutilized because it has a capacity of treating sewage for 10,000 people. The type of a treatment plant is a rotating biological contactor (RBC modular system or Rotor disk). No smells were experienced during a field trip and there people living downstream, and around the plant, said they don’t have any problem with smells and quality of effluent, and actually some of them were using the effluent from the plant to irrigate their gardens. SSFR has sold a number of houses in the estate and will in future sell all the houses. SSFR is still managing the treatment plant, but it is looking for modalities to hand over the management to the residents of the estate.

- **Nyarutarama Constructed Lagoon**

The third sewer network is at Nyarutarama estate. Here under identified as Nyarutarama constructed lagoon. The Laggon was constructed by NPD-COTRACO, a real estate company. Clusters of households built by the company are piped to septic tanks which perform primary treatment. These septic tanks are then piped to a constructed lagoon for secondary treatment. The lagoon is not performing well, because the developer looks like has abandoned it after selling some of the houses to private owners. There is no management and therefore no any maintenance on the facility, which makes people building new houses in the area to also connect their septic tanks to the lagoon. Some houses have gone far to connect their toilets directly to the lagoon, as a result, fresh faeces can be seen floating.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

This final chapter presents overall conclusions and recommendations which are based on the finding of this study. These are geared towards addressing issued raised in research questions and consequently objectives of this study.

5.1 Conclusions

Due to Rwanda decentralization process, the local government has the mandate to prepare, formulate and ensure monitoring and evaluation of sanitation projects while implementation is under local government. The capacity of institutions in charge of sanitation is among the main barrier to achieve sectoral water and sanitation policy objectives. And together with lack of coordination of major players in the sub sector make it not easy to implement effectively sanitation programs. The study suggests capacity building mechanisms and programs at all levels starting from central government to local entities ie MINIRENA, the responsible Ministry of sanitation, and other partner ministries such as MINISANTE, MINEDUC, MINECOFIN; local government institutions ie Kigali City Council and Districts; need strong expertise in sanitation.

There is much emphasis and good will on formulating new policies and strategies but lack of legal instruments (sectoral laws, national guidelines, decrees and standards of application) was found as a major constraint to enforce or implement effectively sanitation and hygiene promotion related policies and strategies. It undermines the only existing organic law. As results solid wastes, human excreta and other liquid wastes are not properly collected, disposed, treated and reused. Sanitation related diseases are still affecting and killing many people in Rwanda, especially children. Lack of adequate data on the real situation of the sub- sector and some information which is available is still fragmented and not centralized. The urgent creation of information system is the solution to scattered and none harmonized data on sanitation and hygiene. Regulatory agencies ie REMA, RURA and RBS are advised to take care of that and ensure the harmonization of their activities and make accessible their information system set-up. Collaboration among themselves is advised to avoid duplication of duties and responsibilities.

There is little financial emphasis on sanitation sub-sector. The mentioned sub-sector was found under-funded at the national level. Significant amount 70.67% in 2006 and 72.52% in 2007 of development budget for the programs and projects was disbursed by external donors. At district level, water and sanitation projects depend on funds from central government and international NGOs, therefore, are yet to have capacity to mobilize enough funds from internal sources. Therefore, there is a need to review financing mechanism of water and sanitation sector by allocating significant amount to

sanitation sub-sector. Moreover, it is necessary to take into account both hardware and software components.

On-site sanitation systems are the only types of excreta management systems that exist in Kigali. Tradition pit latrines are dominant excreta management systems with a proportion of 77.3% of households, compared to automatic flushing toilet with septic tanks of 15.3%, pour flush of 4.4% and VIP% of 2.9%. It was found that 7.2% do not have toilet at all. The numerous number of pit latrines do not meet public health and environmental standards. However the majority of the citizens, 74.35%, strongly accepted alternatives and improved sanitation systems, 21% accepted while 4.6% did not accept any alternative seemed to like what they are using for the time being. Based on considerations for the provision of sanitation facilities; on opportunities and constraints in relation to sanitation technologies of the CoK and based on socio-economic issues surveyed from the study, Ventilated Improved Pit latrines (VIP) are the improved sanitation technologies which are recommended for the community of Kigali city. Hygiene education is recommended for effectiveness of the advised technology.

5.2 Recommendations

Based on the findings and above conclusions of this study, the following recommendations are put forwards:

- The capacity of institutions needs to be enhanced by means of human resources development and training. This will help to get competent human capacity in the sub sector. It is recommended to set a program of capacity building at all levels starting from central government to local entities. This strategy will enhance proper planning, implementation, monitoring and evaluation of policies and strategies.

- It is a treasure to have the three regulatory agencies (REMA, RURA, and RBS) in the country. However together with technical ministries should set and publish sectoral laws, decrees, guidelines and standards for sanitation sub sector to make sure that collection, treatment and recycling of wastes are not causing harm to human health and that wetlands, surface and ground water are protected. It is also recommended to define hygiene norms, guidelines and minimum standards of latrines in the City of Kigali.

- Water and sanitation sector should receive its due recognition and prioritization when planning development projects at National and district level, bearing in mind that they internationally recognized as indicators of sustainable development. Districts self financing mechanism should be improved to raise enough finances to disburse planned projects.

- Ventilated Improved Pit latrines are improved pit latrines which are recommended for Kigali City as individual or public sanitation systems. VIP latrines cancel harmful side effects (smells and flies) related to traditional pit latrines. It is cheap comparing to other improved hygienic systems and can be accessed by the community, skilled labour are accessible since not complicated, it is easy to maintain and different types of cleansing materials both solid and water can be used.

- Promotion and health education are the key elements to achieve adequate sanitation. To this end hygiene promotion program should be in line with any water and sanitation program. Sanitation and hygiene programs such as PHAST, WASH and HAMS are encouraged. These will be used in the process of attitude and behavior changes starting from individual hygiene and will stimulate the demand for sanitation. Local government (districts, imirenge and imidugudu) should be a leading institution to design, implement, monitor and evaluate hygiene promotion and health education programs. Involvement of both women and men should be recognized.

- Further research is required especially on the applicability of centralized sanitation systems in the City of Kigali

REFERENCES

Bakir, Hamed, (2001), *Guiding principles and options for accelerated extension of wastewater management services to small communities in EMR countries*, Amman, Jordan: World Health Organization

Brikké, Francois, Maarten Bredero, Tom de Veer, & Jo Smet (1997), *Linking technology choice with operation and maintenance, in the context of low-income water supply and sanitation*, Geneva: Operation and Maintenance Network of the Water Supply and Sanitation Collaborative Council

Cairn cross, Sandy. (1992), *Sanitation and water supply: Practical lessons from the decade* (Discussion Paper Series No. 9), Washington, DC: The World Bank

City of Kigali, November 2001, *Kigali Economic Development Policy, Final Report*

Drangert, Jan-Olof, Jennifer Bew, & Uno Winblad. (1997), "Ecological alternatives in sanitation: Proceedings from SIDA sanitation workshop." In SIDA Sanitation Workshop (Ed.), *Publications on water resources* (No. 9), Balingsholm, Sweden: Department for Natural Resources and the Environment & Swedish International Development Authority (SIDA)

Esrey, Steven A., Jean Gough, Dave Rapaport, Ron Sawyer, Mayling Simpson-Hébert, & Jorge Vargas. (1998), *Ecological sanitation*, Stockholm, Sweden: SIDA

Esrey, Steven A., Ingvar Andersson, Astrid Hillers, & Ron Sawyer. (2000), *Closing the loop: Ecological sanitation for food security* (Publications on Water Resources No. 18), Mexico: SIDA

Gotaas, Harold B. (1956), *Composting: Sanitary disposal and reclamation of organic wastes* (Vol. 31), Geneva:WHO

Havelaar, Arie, Ursula J. Blumenthal, Martin Strauss, David Kay, & Jamie Bartram. (2001), "Guidelines: The current position." In Lorna Fewtrell & Jamie Bartram (Eds.), *Water quality: Guidelines, standards and health*, London: WHO

Institute National de la Statistique du Rwanda (INSR), (2005), *Demographic and Health Survey*, Kigali-Rwanda

Jha, P.K. (2005, September), *Sustainable technologies for on-site human waste and wastewater management: Sulabh experience,* Paper presented at the Hands-on Workshop on Sanitation and Wastewater Management, Asian Development Bank, Manila, Philippines. Available online at http://www.a-

db.org/Documents/Events/2005/Sanitation-WastewaterManagement/paper-jha.pdf, retrieved on Tuesday, 4th March, 2008

Johansson, Mats, Håkan Jönsson, Caroline Höglund, Anna Richert Stintzing, & Lena Rodhe. (2001), *Urine separation—Closing the nutrient cycle,* Stockholm, Sweden: Stockholm Water Company. Available online at http://www.stockholmvatten.se/pdf_arkiv/english/Urinsep_eng, retrieved on Friday, 15th February, 2008

Kabalisa, E. (2007), *Water Supply and Sanitation Situational Analysis and way forward proposal for Kigali City, Rwanda,* University of Dar es Salaam

Kalbermatten, John M., DeAnne S. Julius, Charles G. Gunnerson, & David D. Mara. (1981), *Appropriate technology for water supply and sanitation*, Washington, DC: The World Bank

Mara, Duncan. (2004), *Domestic wastewater treatment in developing countrie,* London: Earthscan

M. Henze, 1997, *Journal of water science and technology,* Vol. 35, No. 9, pp. 133-120

MINECOFIN, 2003, *Integrated Survey on Households Living Conditions (EICV1),*

Kigali-Rwanda

MINECIFIN , 2006, *Integral Survey on Households Living Conditions (EICV2)*, Kigali – Rwanda

National Institute of Statistics, (2005), *Rwanda Development Indicators*

Peasey, Anne. (2000), *Health aspects of dry sanitation with waste reuse*, London: Water and Environmental Health at London and Loughborough

Prüss-Üstün, Annette, David Kay, Lorna Fewtrell, & Jamie Bartram. (2004) "Unsafe water, sanitation and hygiene." In Majid Ezzati, Alan D. Lopez, Anthony Rodgers & Christopher J.L. Murray (Eds.), *Comparative quantification of health risks: Global and regional burden of disease attribution to selected major risk factors* (pages 1321–1352), Geneva: WHO.

Recencement de la pululation du Rwanda, 2002, *Recencement General de la population et de l'Habitat*, National Department Cencus

Republic of Rwanda, fiscal year 2007, *Development budget by programme, sub programme and project*, www.minecofin.gov.rw, retrieved on Wednesday, 16th April, 2008

Republic of Rwanda, *Development budget by programme, sub programme and project, fiscal year 2007*, www.minecofin.gov.rw, retrieved on Wednesday, 16th April, 2008

Republic of Rwanda, *Annex II-5: State expenditure per Budget Agency, Programme and Sub Program 2008,* www.minecofin.gov.rw , retrieved on Wednesday, 16th April, 2008

Robinson, Andy. (2002), *VIP latrines in Zimbabwe: From local innovation to global sanitation solution,* Nairobi, Kenya: The World Bank

RoR.2001. Republic of Rwanda, *National Decentralization Policy*, Rwanda

RoR.2003. Republic of Rwanda, *National Environment Policy*, Rwanda

RoR.2004. Republic of Rwanda, *Rwanda Vision 2020,* Rwanda, Version June 2004

RoR.2004. Republic of Rwanda, *Sectoral Water and Sanitation Policy*, Rwanda

RoR.2006. Republic of Rwanda, *Environmental Health Policy,* Rwanda

RoR.2005. Official Gazette of the Republic of Rwanda: *Organic Law Determining the Modalities of Protection, Conservation and Promotion of Environment*, Rwanda

GoR.2007. *Economic Development and Poverty Reduction Strategy*, 2008- 2012

Spaargaren, G., et al, (2005), Mixed Moderrnities: *Towards viable urban environmental Infrastructure development in East Africa* (Position paper, Environmental Policy group (ENP) Wageningen University, for PROVIDE Project)

Taylor, K. J. Parkinson, J. Colin, Urban Sanitation, 2004: *A guide to strategic planning*, London

Torsten Krekeler, 2005: *general options for groundwater protection* (Kabul water conference and workshop)

Van Vliet, B., 2004: *The Sustainable transformation of Sanitation*; Development of technology and policy, p.337-353

Van Vliet, B., 2006 in P.P Verbeek and A. Slob (eds), *User behavior and technology development: Shaping sustainable relations between consumers and technologies*, p.p 309-318, Published by Springer

WHO/ UNICEF Report, 2006: Meeting the MDG: *Drinking water and sanitation target*: The urban and rural challenges of the decade

WHO (2006): *Guidelines series on the safe use of wastewater, excreta and greywater in agriculture and aquaculture*, http://www.who.int/water_sanitation_health/wastewater/gsuww/en/index.html, retrieved on Monday, 5th May, 2008

WSP et al. 2006, *Water and Sanitation Program Getting Africa on Track to Meet the MDGs on Water and Sanitation*: A Status Review of Sixteen Countries.

Zeeman, G and Lettinga, G. (1999), *The role of Anaerobic Digestion of Domestic Sewage in Closing the water and Nutrient Cycle at Community Level*, The Journal of water Science and Technology, Vo. 39, No. 5, pp.197-19

APPENDICES

Appendix A: Closed-Ended Questionnaire for household members

A. Generals

1. Where is your house located?

Cell……Sector…….District…….

2. For how long have you been there?

Between 0-5 years ☐ Between 6-10 years ☐

Between 11-15 years ☐ Above15 ☐

3. How old are you?

Between 18-25 years ☐ Between 26-35 years ☐ Between 36-45 ☐

Between 46-55 years ☐ Between 56-65 years ☐ Above 65 years ☐

4. Sex: Female ☐ Male ☐

5. Marital status: Single ☐ Married ☐ Widow ☐

6. Level of education: Primary ☐ Secondary ☐ University ☐

7.What is the size of your family?

1person ☐ 2-3 people ☐ 3-4 people ☐

5-6 people ☐ 7-8 people ☐ Above 8 people ☐

8. What is your occupation? …….

9. What is your monthly family income?

Bellow 25, 000Rwf ☐ Between 25,000 and 50000Rwf ☐

Between 50,000 and 100000Rwf ☐ Between 100,000 and 150,000Rw ☐

Between 150, 000 and 200,000Rwf ☐ Above 200,000Rwf ☐

B. **Utilities and services available to the household**

10. Do you get drinking water on the tap at your house from ELECTROGAZ?

Yes ☐ No ☐

i) If YES, to what extent do the water you get meet your needs?

Over 80% ☐ Between 60 -80% ☐ bout 50% ☐ low 25% ☐

ii) If NO, Where do you get drinking water from?

I buy water from a water kiosk ☐ uy tap water from a neighbors ☐

I fetch water from the well near my house ☐ fetch drinking water from the valley/river ☐

Others, specify……

iii)I am satisfied with drinking water I get from the sources mentioned above ☐

11. I don't have access to tap water because.....

I can not afford bills from ELECTROGAZ ☐

ELECTROGAZ is not capable of bringing water to my house ☐

Others reasons, specify……..

12. Do you have a toilet? YES ☐ NO ☐

i) If YES what kind of a toilet do you have?

Simple/traditional Pit latrine ☐ VIP ☐

Pour-flush latrine piped to a soak pit ☐ Automatic flushing toilet piped to a septic tank ☐

Others, specify……..

13. How do you dispose the wastewater you produce at your house?

I pour the wastewater in the common/public drainage ☐

I pour the wastewater in a constructed soak pit at my house ☐

I pour wastewater outside my house ☐
The wastewater goes into a sink piped to a septic tank ☐
Others, specify…….

C. **Cultural and social factors affecting sanitary and hygienic practices**

14. What are the anal cleaning material do your family uses?

Toilet papers ☐ other papers ☐ Water ☐

Others, specify……

15. The attitude on waste-handling:

How often do you wash hands after using toilet in percentage of time?

100% ☐ 75% ☐ 50% ☐ 25% ☐ 0%/never ☐

D. **Proposal on improved sanitation facilities**

16. Are you satisfied with the type of toilet and sanitation system facilities you have?

YES ☐ NO ☐

17. If no, which of the following factors is the major constraint to have your desired type of toilet?
Cultural factors ☐ Economic factor ☐ Technological factors ☐

Plot Geographical location or Topography ☐ Plot size ☐

17. If there could be improved sanitation systems, would you adopt them for alternatives? Yes ☐ NO ☐

If no, for what reason……..

18. I am willing to participate in the provision and management of the improved sanitation systems
I strongly agree ☐ I agree ☐ I don't agree ☐ I strongly disagree ☐

Thank you for your participation