KENYATTA UNIVERSITY

SCHOOL OF ENVIRONMENTAL STUDIES

DEPARTMENT OF ENVIRONMENTAL PLANNING AND MANAGEMENT

Impact of Residential Development on Urban Wetlands: The Case of Watiti Wetland, Kangemi Estate, Nairobi County.

By

STELLA NYASUGUTA GUTO

N36/2798/2010

Studio Report

Submitted in partial fulfillment of Bachelor's Degree course in Environmental Planning and Management

DECLARATION BY THE CANDIDATE

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

Signature ……. Date…….

Stella Nyasuguta Guto

This report has been submitted for examination with my approval as the University supervisor

Signature…… Date……

Ms. Carolyn M. Getao

Signature ……. Date ……..

Mr. Allan Kirui

ACKNOWLEDGEMENT

This project is a product of a research conducted on Impacts of Encroachment of Watiti wetland by Residential Developments. The report is what it is due to the generous contribution and assistance of a number of organizations, institutions and individuals both within and outside Kenyatta University.

I wish to extend my most special thanks to my Research Project Lecturer Mr. Kirui for the information and guidance of how to carry out report writing, and to my supervisor Ms. Carolyn M Getao for her continuous assistance and professional guidance which played a major role in the improvement and perfection of this report.

My sincere gratitude also goes to the institutions interviewed for their dedication in responding to issues and questions in the process of acquiring information about urban wetland management. I am also grateful to the local communities living around Watiti wetland for providing ground information through questionnaires and photography and also the local CBO's who gave guidance and a lot of relevant information and their views on urban wetland management.

Finally, I wish to convey my heartfelt gratitude to all who contributed to this exercise, but whose names have not been stated in this report.

ABSTRACT

The UN Millennium Ecosystem Assessment determined that environmental degradation is more prominent within wetland systems than any other ecosystem on Earth. Increase in population in urban areas has led to pressures within urban wetland ecosystems. Urbanization has also contributed to the degradation of the Watiti wetland ecosystem. Some of the impacts of such activities include; direct habitat loss (from development, land reclamation, roads, in-stream dredging), altered water regime (from dams/barriers, stream redirection, hard surfacing, water extraction), pollution (from garbage, sewage, oil and chemical spills, pesticides, airborne toxins), introduction of exotic species (weeds, pests and domestic pets) and other ecosystem modifications (for example, altered fire regimes, dieback and changes in salinity). International conservation efforts are being used in conjunction with the development of rapid assessment tools to inform people about wetland issues. The above scenario necessitated this study in order to identify the impacts of encroachment, to assess the policy and legislation framework for managing urban wetlands, to establish the contribution of the public in wetland management and to examine measures taken to effectively protect and conserve the wetland. To obtain information for this study, both primary and secondary data were used. Primary data was obtained using various methodologies like field surveys, photography, observation, guided questionnaires and oral interviews while secondary data heavily borrowed from the existing published and unpublished data. The target population is the upper, middle and lower class individuals living around the Watiti wetland. The analysis revealed the status quo of urban wetland management and established existing gaps within institutions and the policies. This study identifies the impacts of encroachment of residential development on urban wetland, the case of Watiti wetland and recommends for ways to ensure that the wetland is protected and conserved for sustainability.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF PLATES

ACRONYMS

EMCA Environmental Management Coordination Act

CBO Community Based Organization

USEPA United States Environmental Protection Agency

GoK Government of Kenya

UN United Nations

MEA Millennium Ecosystem Assessment

WRUA Water Resource Users Association

UNEP United Nations Environmental Programme

NWWG National Wetlands Working Group

CBD Central Business District

NGO Non-Governmental Organization

EIA Environmental Impact Assessment

NEMA National Environmental Management Authority

WRMA Water Resource Management Authority

CAAC Catchment Area Advisory Committee

NCC Nairobi County Council

KNBS Kenya National Bureau of Statistics

CHAPTER ONE: INTRODUCTION

1.1 Background of the problem

Historically, the concept of urbanization has been related to specialized industrialization and consequent economic development. Urbanization is a territorial response to structural changes in the economy. Unregulated and unguided urbanization has its own problems as evidenced in the deteriorating environmental conditions of many large cities. Sustainable urban settlements have to be environmentally sound, economically efficient and socially contributing to the sense of the community (Sharma P., 1989). Urbanization is a major cause of impairment of wetlands and has resulted in direct loss of wetland acreage as well as degradation of wetlands (USEPA 1994b).

Wetlands were defined at Ramsar Convention 1971 as "areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salty, including areas of marine water the depth of which at low tide does not exceed six meters". This definition was further expanded to include a variety of natural systems, such as marshes, swamps, bottomland hardwoods and pocosins (DCM, 2007)

The Kenyan definition of wetlands is "areas of lands that are permanently or occasionally water logged with fresh, saline, brackish or marine waters, including both natural and man-made areas that support characteristics biota"

Wetlands act as sources and reservoirs of water resources. They recharge and discharge water, hence playing an important role in the water cycle (Wandiga, 1996). Wetlands cover less than 9% of the earth's land surface, but provide habitat to disproportionately high numbers of species (Zedler and Kercher 2005; Dudgeon et al. 2006), such as water birds, amphibians, fish, invertebrates and variety of flora (Mitsch and Gosselink 2000). Wetlands also offer ecosystem

services such as water purification, flood control, nutrient cycling and carbon sequestration (Zedler and Kercher 2005, Daniels and Cumming 2008)

Wetlands are among the most productive ecosystems due to their functions and attributes. However, over the years they have faced destruction and are on the verge of distinction. The international community realized this outcry and the effects it would have to flourish on human and therefore converged in Ramsar, Iran to come up with Ramsar convention on wetland protection (Ndungu B. 2013).

The Ramsar Convention raises concern that many wetlands in urban environments are becoming and are, degraded through encroachment of surrounding populations, pollution, poor waste management and infilling or other developments, hence these activities have diminished both the ecosystem services that urban wetlands can provide moreover the recognition of their value and importance by both decision makers and urban communities.

Globally wetlands occupy about 6% of the earth's surface and this ranges from 5.3% to 12.8% million km^2. Kenya's wetlands occupy about 3-4%, which is approximately 14,000km^2 the land surface and fluctuates up to 6% in the rainy seasons. However, due to high rates of wetlands and catchment degradation, the total percentage of wetlands area is estimated to be below 2% (GOK, 2008).

Wetlands are essential to the well being of Kenyans as they contribute significant economic and social benefits to the country. Despite their high productivity and provision of many benefits, wetland ecosystems in Kenya are still facing serious threats. They are subjected to encroachment and exploitation countrywide because of their resilience to extended drought thereby making them the main source of water for drinking and irrigation. (Japheth O., 2010). This has not only

been a phenomenon in Kenya rather it is a bigger picture of the impacts of encroachment of wetlands worldwide. (Ndungu B. 2013). The effects are more in the urban areas due to the rapid urbanization that is estimated at an annual growth rate of 1.6% (UN, 2009).

Many wetlands in Kenya have continued to experience an array of pressures and threats emanating from both the natural events and anthropogenic activities as 80% of wetlands occur on lands, which are privately or communally owned, and without any serious conservation measures (Ndungu B. 2013),

Wetlands are considered as fragile ecosystem and are highly vulnerable due to anthropogenic activities (settlement, agriculture). In the past, wetlands have been regarded as 'wastelands', which harbor disease vectors. This has led to large-scale drainage and conversion for alternative uses without giving regard to ecological and socio-economic values.

Based on this background, this study explores the effects of encroachment of residential development on Watiti Wetland in Kangemi Estate, Nairobi County.

1.2 Statement of the problem

There is growing concern and awareness both at national in international level, that many forms of development activities are causing environmental and natural resource degradation (Flint, 2004). Within the last 50 years, ecosystems have been altered more rapidly and extensively than in any other period of history (MEA, 2005). This has led to an unprecedented transformation of freshwater ecosystems and consequently biodiversity loss, with over half of the world population living in river basins (MEA, 2005; GWP, 2004a).

Drainage and reclamation of wetlands for agriculture development, human settlement, tourism development, and industrial development are some of the biggest threats to wetland conservation and management.

There has been a rapid population increase due to rural, urban migration leading to increase of housing units in the recent years in Kangemi and this has had a major impact on Watiti Wetland which has been encroached to give way for increased housing demand. This continues to exert pressure on limited land resources, resulting in a decline of wetland quality and services as well as quantity of products derived from the wetland. With the destruction of the wetland, problems of pollution, biodiversity loss and reduction of water levels in the wetland and in general the river profiles that depend on them have reduced tremendously. Quality of raw and natural water has dropped and marred. This, in turn, has caused the cost of water treatment to escalate.

Encroachment is done by both the informal and formal settlement sectors with both persisting to meet both financial and shelter needs. Policies and regulations set up to ensure that the wetlands are conserved have long been ignored and not fully implemented with corruption being a major contributor.

1.3 Research questions

1. What policies and legislations have been set to protect and conserve urban wetlands?
2. What are the effects of anthropogenic activities on Watiti wetland?
3. What is the contribution of Community Based Organizations in ensuring protection and conservation of Watiti Wetland?
4. What are measures can be taken to ensure that the wetland is protected and conserved?

1.4 Research Objectives

1.4.1 General Objective

The overall objective of this study is to assess the effects of encroachment of residential development on Watiti Wetland and come up with measures to protect and conserve the wetland

1.4.2 Specific Objectives

1. To examine the existing legislation and policy framework that deal with protection and conservation of the wetland
2. To examine the effects of anthropogenic activities taking place on Watiti wetland.
3. To establish the contribution and participation of the public and other organizations, for example WRUAs, in dealing with encroachment.
4. To recommend ways of protecting and conserving of the wetland to safeguard its continuity and existence.

1.5 Research premises

1. Measures have been taken to formulate policies and legal frameworks to protect wetlands.
2. The anthrogenic activites carried out have a lot of negative impacts on Watiti wetland.
3. Community Based Organizations and the public actively participate in ensuring various wetlands are recognized and protected.
4. Nothing so far has been done to protect those already threatened wetland.

1.6 Justification of study

Watiti Wetland is the main source of River Watiti that joins the Nairobi River. In the past, it used to cover a larger area of Kangemi and overtime has rapidly reduced in coverage. With this reduction, there has been a huge impact on the wetland generally. Water levels have reduced, wetland degraded, biodiversity loss among others. Judging from the challenges and the importance of protecting wetlands, it is fundamental to give focus on the way forward in protecting this area.

Watiti Wetland was chosen as a case study because the researcher is familiar with the area and with the skills and knowledge acquired on the importance of catchments the researcher saw the importance of putting into practice by being involved in research of how it can be protected. The Catchment is now in competition with residential developments putting it at a high risk of degradation and depletion.

This study is also meant to gather information and data on the effects of residential developments on water resources, and as a result generates a useful and informed measure on how to tackle the challenges.

1.7 Significance of the study.

The study is meant to ensure the protection and conservation of the wetlands to safeguard their continuity through fencing and pegging to demarcate boundaries and prevent further encroachment and also planting of trees to improve water quality and water percolation into the soil. Through creation of awareness on the importance of wetlands and involvement and participation of the community at large in ensuring that the wetland and its environs is protected the benefits of them will be realized and appreciated.

The study will also go a long way in providing information that can guide decision makers in policy decision making on wetlands in light of the current population growth rates and increasing catchment degradation.

The study is fundamental in ensuring that Watiti Wetland in Kangemi is given priority, conserved and well managed since it is depended on for continuity of livelihood through provision of water for domestic, industrial and recreational purposes.

1.8 Scope and limitation of the study

The study will cover the Watiti Wetland and will be focused on examining the impacts and effects of development of residential units on the catchment and also the contribution of the community, if any, in the management of resources. Various CBOs and institutions will be involved in carrying out my research, including WRUA and Ministry of Environment, Water and Natural Resources. Maps and photographs will be used to indicate the extent of wetland encroachment.

The study will be limited to Watiti Wetland area due to the intensity of its degradation and rapid encroachment and is also a source of river Watiti that is a tributary of the Nairobi River.

1.9 Operational Definition of Terms

Biodiversity-means the variability among living organisms from all sources including ecosystems and the ecological complexes of which they are a part. It encompasses the ecosystem, species and genetic diversity

Biota- All plant and animal life of a particular region

Environment degradation- Is the deterioration and compromising of the environment in some way through depletion of resources such as air, water and soil. It is the destruction of ecosystems and the extinction of wildlife

Formal settlements- Is a located area for housing that has amenities such as electricity and sanitation added to it.

Fragile ecosystems- This is an ecosystem which has been adversely affected by forces of nature resulting in the destabilization of the balance of the living and non-living organisms in it and making it vulnerable to destruction

Hydrologic system- this is a system of interrelated components, including the processes of precipitation, evaporation, transpiration, infiltration, groundwater flow and stream flow, in addition to those structures and devices that are used to manage the system

Informal settlements- This are unplanned settlements and areas where housing is not in compliance with current planning and building regulations and occupants have no legal claim to, or occupy area illegal areas**.**

Sustainable use- means present use of the environment or natural resources, which does not compromise the ability to use the same by future generations or degrade the carrying capacity of supporting ecosystems;

Urban wetland-Natural wetlands or riparian areas restored or enhanced for habitat, but with urban runoff as primary water source.

Wetland- This is a zone that collects and filters natural water (rain, dew and snow). It is a zone through which the rainwater and snow seeps to eventually provide base flow to rivers, lakes and spring water and also provides for groundwater recharge.

Wetland functions - The physical, biological, chemical, and geological interactions among different components of the environment that occur within a wetland. There are many valuable functions that wetlands perform, but these can be grouped into three categories: functions that improve water quality, functions that change the water regime in a watershed such as flood storage, and functions that provide habitat for plants and animals.

Wetland services-Benefits that result from a wetland function

Wetland restoration - the reestablishment of a disturbed or altered wetland as one with greater function or acreage. This may involve reestablishing original vegetation, hydrology, or other parameters to reestablish original or closer-to-original wetland functions

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

A negative perception of wetlands as 'wastelands' coupled with increasing human populations and changing lifestyles has led to the loss and degradation of wetlands through conversion into other land uses such as agriculture, pastureland, fish farming and residential areas (Owino and Ryan 2007; Macharia and Thenya 2007a, 2007b), that are perceived to be more profitable. Urbanization of areas surrounding a wetland frequently has serious consequences for the ecosystem. Any development upstream and in some instances downstream, can negatively impact a wetland's function. Wetlands provide many ecological benefits such as pollutant removal, flood attenuation, ground water discharge, shoreline protection, recreational areas and support of natural resources. Typically, the cost of replacing a natural wetland is greater than the benefits obtained by developing it (Lawrenz, Mallonee & Simmons, 2012).

Several wetlands are under increasing pressure and in the process of losing many of their important functions, with serious consequences of changed water regimes, significant conflicts over resource use and loss of livelihood opportunities. Many wetland areas experience a rapidly growing population with poor people moving into the areas in search of livelihood opportunities leading to a strong economic pressure of conservation of wetlands to other functions and only limited considerations are given to the sustainability of changes (Kithia, 2001; Wandiga, 1996).

The Millennium Ecosystem Assessment (MEA) reported that the degradation and loss of wetlands, and the deterioration of freshwater and coastal wetland species, are more rapid than that of other ecosystems (Millennium Ecosystem Assessment, 2005).

Planning of land and resource use in wetlands is limited and furthermore plans are seldom put into practice, Coordination of the activities taking place on the ground in the wetlands is exceedingly difficult and the skills for undertaking wetland management are insufficient. The knowledge base about wetland resources, status and key management problems is limited and no proper policy guidance is in place (Khroda, 2002).

2.2 Impacts of Urbanization on wetlands

The increased burden of urbanization threatens the quality of air and water, thereby impacting the natural and living environment (UN-HABITAT, 2008). The hypothesis that urbanization can have direct or indirect impacts on the environment, and that wetlands are particularly susceptible to negative change, has long been proven (Darnell, 1976; Maltby, 1986). Yet despite this, the much of urbanization continues to destroy and degrade natural capital.

2.2.1 Direct impacts on wetlands

These include development of wetlands for the purposes, which often involve dredging, filling and draining the area, and are altered by activities occurring inside the wetland boundary. Examples include draining wetlands for agricultural use by constructing drainage ditches or installing underground drainage tiles and filling wetlands to provide useable land on which to build. (Lawrenz, Mallonee & Simmons, 2012).

To facilitate city development rapid and unplanned land reclamation has been achieved by infilling swamps and floodplains (Adelekan, 2009). Not only has this impacted directly on wetland biodiversity, destruction of forests and wetlands has reduced the flood storage capacity of the land resulting in increased flooding. McGranahan et al. (2007) noted that while economic activity and urban development often increase the environmental pressures that lead to flooding,

it is usually the low income settlements and poorest groups within the urban settlements that tend to be the most vulnerable.

The relatively flat terrain associated with river floodplains and estuarine wetlands is easier to urbanize than upland areas, resulting in a concentration of human developments on these habitats (Zedler and Leach, 1998). This has resulted in a progressive direct loss of coastal and floodplain wetlands around the globe, through activities such as drainage or infilling, and indirect degradation, through activities away from these areas such as water abstraction or conversion of wetlands to agricultural and settlement lands (Lee et al., 2006; Bolca, et al., 2007)

Dahl (2002) estimates that 105.5 million acres of wetlands were present in 1997. Historically, most wetland loss has occurred in freshwater wetlands.

2.2.2 Indirect impacts on urban wetlands

These originate outside of the wetlands through the alteration of the hydrological system. Hydrologic changes through land development compound as vegetation is removed, which intercepts rainfall, the soil is compacted, impervious surfaces are created and drainage systems are installed. This creates hydrologic stressors of increased ponding (alters the ecosystem and paves way for invasive species that can adapt to new conditions), increased water level fluxuation (as a result of impeded buffering of storm runoff creating acute flood hazards and greatly impacting the stability of water ways and emergent habitat), flow constrictions (they can fill with sediments reducing the flow volumes across barriers limiting linkage between upstream and downstream), decreased ground water discharge (through impervious structures and storm sewer systems) and hydrological drought that is brought about by channel deepening which occurs during episodic high discharge events (Lawrenz, Mallonee & Simmons, 2012).

2.2.3 Cases of wetlands loss

The US national wetland inventory provides a wealth of details on the quantities scale of wetland losses by region, by type and overtime. An analysis of the wetland losses between the 1970s and the 1980s indicates that 53% loss occurred in the conterminous U.S (Judith, 2001; DCM, 2007). The least impact has occurred in the Alaska where the states massive 170 million acres of wetland resources have only suffered only 1% loss. Next lowest losses occurred in Hawaii (12%), New Hampshire (9%) and Rhode Island (37%). Ohio and California have lost most at 90% and 91%, respectively (Judith, 2007).

In Canada, high level of quantitative information on losses of wetlands is available. In a study carried out by the National Wetlands Working Group in 1988, it was observed that 65% of Atlantic tidal and salt marshes, 70% of the lower Great Lakes-St Lawrence River Shoreline marshes and swamps and 80% of pacific coast estuarine wetlands are estimated to have been converted to other uses. Primarily, this is due to agriculture drainage, urban and industrial expansion to construction of road ports and hydroelectric facilities and increased demand of recreational facilities (NWWG, 1998).

In Europe, the most recent overview of the extent of wetland loss indicates that overall wetland loss exceeds 50% of the original area (UNEP, 2005). This is reported in areas like Netherlands, Germany, Spain, Greece, France, Italy and parts of Portugal (Judith, 2007).

The situation concerning wetland losses in Africa is characterized by an extreme paucity of published quantitative studies. This may reflect both generally lower rates of wetland losses than in industrialized regions, but also the lack of capacity to undertake the studies in many countries. For example, in a review of wetland inventories in South Africa gives some information is given

regarding the extent of wetland resources in 10 countries in the region (Olago & Aketch, 2000). Loss figures are given for Natal-the Tugela Basin, where over 90% of the wetland resources have been lost in parts of the basin; and the Mfolozi catchment where 58% of the wetland has been lost. The other is that of the wetland inventory of Tunisia which reports an overall loss of 15% of wetland area (Ohayo, 1996).

2.3 Policy and Legal Framework

This section focuses on the policies and legislative frameworks that relate to the conservation, protection and management of wetlands both internationally and nationally.

2.3.1 Ramsar Convention on Wetlands

The Wetland or "Ramsar" Convention is the oldest of the global nature conservation treaties, and the only one that is dealing with a particular ecosystem.

This is the only global environmental treaty that is associated and deals with the environment. It is an intergovernmental treaty that provides the framework for national action and international cooperation that provides for the conservation and sustainable use of wetlands and their resources through local, regional and national action.

The Convention was signed in Ramsar, Iran on 2nd February 1971, and came into force in 1975. To date, there are 168 Contracting Parties to the Convention up from 119 in 1999, with now 2,122 wetland sites known as Ramsar sites covering 205,366,160 ha (507,470,800acres) up from 1,021 sites in 2000.

Its objective is to protect and conserve a particular ecosystem and the flora and fauna that depend on it. The key obligation is to are those concerning land-use planning, the designation of one or

more wetlands for inclusion in the “List of Wetlands of international importance” and their conservation and finally the promotion of the protection of wetlands in general.

In the sphere of physical planning the Convention requires (that planning must be carried out so as specifically to promote the conservation of the Wetlands included in the list and generally to promote as far as possible the wise use of wetlands.

2.3.2 Convention on Biological Diversity

The Convention was opened for signature on 5 June 1992 at the United Nations Conference on Environment and Development (the Rio "Earth Summit").The Convention on Biological Diversity was inspired by the world community's growing commitment to sustainable development. It represents a dramatic step forward in the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of benefits arising from the use of genetic resources.

The World Summit on Sustainable Development held in Johannesburg 2002 recommended partnership between governments, private sectors and the public at large to enhance management of wetlands. It also focused on sustainable development - that the existing generation meets the needs of the present generation without compromising the ability of the future generation to meet their own needs.

Kenya is also a signatory to the numerous international treaties and conventions. It is therefore committed to implement recommendations from global initiatives on environmental sustainable development, such as United Nations Summit held in 2000,wherein nearly all world leaders endorsed a set of eight time bound and measurable goals, named “the Millennium Development Goals” so as to combat environmental degradation, among other global problems.

2.3.3 Government regulations guiding Wetlands management in Kenya

National Wetlands Policy

For a long time, wetlands conservation in Kenya has been cross-sectoral in nature with no specific institutions charged with the management A number of government agencies, NGOs and community based organizations have in various capacities implemented wetlands conservation, management and utilization in a manner that has not always been consistent with previous or existing efforts due to the absence of a coordinated National Wetland Policy . The process for developing a wetlands management policy was initiated, but lack of focus and overlapping jurisdiction made it impossible to conclude and gain consensus on the matter. The Kenya Wildlife Service presently manages wetlands protected under the RAMSAR Convention. The Policy spells out clearly eight objectives to achieve its aim. The draft Policy seeks to:

- Establish an effective and efficient institutional and legal framework for integrated management and wise use of wetlands which will provide an enabling environment for the participation of all stakeholders.
- Enhance and maintain functions and values derived from wetlands, protect biological diversity and improve essential processes and life support systems of wetlands.
- Promote communication, education and public awareness among stakeholders to enhance their participation in wetland conservation.
- Carry out demand driven research and monitoring on wetlands to improve scientific information and knowledge base.
- Enhance capacity building within relevant institutions and for personnel involved in conservation and management of wetlands.

- Establish a national wetlands information management system and database including tools and packages to targeted groups.
- Promote innovative planning and integrated management approaches towards wetlands conservation and management in Kenya.
- Promote partnership and co-operation at regional and international levels for the management of trans-boundary wetlands and migratory species.

Sessional paper No.6 of 1999

This sessional paper elucidates on the connection between environment and development, highlighting the key environmental challenges. It provides priorities for action, implementation strategies, and capacity building. It states that the overall goal is to integrate environmental concerns into the national planning and management processes and provides guidance for environmentally, socially and economically sustainable development.

The National Environmental Policy 2013

This policy proposes a broad range of measures and actions responding to key environmental issues and challenges. It seeks to provide the framework for an integrated approach to planning and sustainable management of natural resources in the country. It recognizes the various vulnerable ecosystems and proposes various policy measures not only to mainstream sound environmental management practices in all sectors of society throughout the country but also recommends strong institutional and governance measures to support the achievement of the desired objectives and goal.

The Environmental Impact Assessment and Audit Regulations, 2003

These are entrenched under section 147 of the EMCA. The regulations provide the framework for carrying out EIAs and EAs in Kenya before conducting any project. This helps in identifying the impacts of a project and deriving the mitigation measures to these impacts.

NEMA should oversee the implementation of this policy. Any project, before its commencement should undergo through screening to identify its impacts to both the social and environmental surroundings. It should therefore give permits to those projects and developments whose benefits exceed their cost.

Physical planning act, 1996 (Cap. 286)

This was an Act of Parliament to provide for the preparation and implementation of physical development plans and for connected purpose.

If in connection with a development application, a local authority is of the opinion that proposals for industrial location, dumping sites, sewerage treatment, quarries or any other development activity will have injurious impact on the environment, the applicant shall be required to submit together with the application an environmental impact assessment report.

Building Code: The Local Government (Adoptive By-laws) (building) Order 1968

It was established and enacted by the local authorities. They defined the building specifications and the quality of building material to be used. Connection to common facilities such as sewers, electricity and water pipelines was also defined.

Environment management and Coordination Act (EMCA, 1999)

This is the superior environmental law in Kenya. The main objective of this act is the establishment of an appropriate legal and institutional framework for the management of the environment in Kenya. The Act further aims to improve the legal and administrative coordination of the diverse sectoral initiatives in the field of environment so as to enhance the national capacity for its effective management. The ultimate objective is to provide a framework for integrating environmental considerations into the country's overall economic and social development.

In terms of environmental management, the EMCA 1999, provides a comprehensive and an appropriately harmonized legal an institutional framework for the handling of all environmental issues in Kenya.

Part VI (Section 68) of the Act makes it mandatory for an Environmental Impact Assessment (EIA) to be conducted for proposed projects.

2.3.4 Relevant institutions

The National Environment Management Authority (NEMA)

This is the government authority charged with the general supervision and coordination of the environment matters in Kenya. NEMA is the principal instrument of the government charged with the implementation of all policies relating to the environment. It came up because of EMCA that came to effect on the 14th of January 2000.

The functions of NEMA with regards to wetland management is to promote the integration of environmental considerations into development policies, plans, programmes and projects, with a

view to ensuring the proper management and rational utilization of environmental resources, on sustainable yield basis, for the improvement of the quality of human life in Kenya, to take stock of the natural resources in Kenya and their utilization and conservation and to examine land use patterns to determine their impact on the quality and quantity of natural resources.

.It is therefore the government's watchdog in ensuring the management and conservation of environmental resources like wetlands.

Nairobi County Council

The main objective of the Council is to facilitate coordinated development and improve service delivery that would stimulate economic activity. and high quality of life to its residents who reside in its area of jurisdiction. It is responsible for ensuring a clean and healthy environment.

Water Resource Management Authority

The Water Resource Management Authority (WRMA) is a state corporation under the Ministry of Water and Irrigation established under the Water Act 2002 and charged with being the lead agency in water resources management. In order for WRMA to undertake its stipulated responsibilities, the Act provides for decentralized and stakeholder involvement. This will be implemented through regional offices of the Authority based on drainage basins (catchment areas) assisted by Catchment Area Advisory Committees (CAACs). At the grassroots level, stakeholder engagement will be through Water Resource User Associations (WRUAs). Among its objective is to manage and protect water catchments.

2.4 Measures taken on protection and management of wetlands

An important component of wetland protection and management is to identify what wetland functions need to be protected, and which wetlands need additional protection because they have other important characteristics. Wetland functions can be grouped into three broad categories: water quality improvement, hydrologic functions, and habitat functions. In addition to identifying what functions need to be protected, managing wetlands requires an understanding of how the functions are performed.

The two most common methods for protecting wetland functions have been the use of buffers and compensatory mitigation. Buffers are used to maintain existing functions by reducing the impacts of adjacent land uses. When impacts to wetlands are unavoidable, replacement of lost functions has typically been through compensatory mitigation in which other wetlands are created, restored, or enhanced using specific ratios based on area (Hruby 2004a,b). Review of recent scientific information has shown that protecting the functions of wetlands by using only buffers and establishing “mitigation ratios” adequate since it considers providing protection in the immediate vicinity of a wetland and not disturbances that may occur elsewhere in the landscape.

2.5 Gap identification

Research has been conducted on wetland protection and conservation and strong policies and legislations made, but the implementation bit is usually faced by a lot of challenges and difficulties due to weak and lack of independence in the existing institutions. Monitoring and evaluation on the wetland management strategies is also inadequate explaining why, even after

rich information on the important values and roles they play, wetland degradation rates and loss is on increase all over the world.

Knowledge gap in the values of urban wetlands and their functions and the magnitude of effects of encroachment by residents/dwellers, "ignorance by residents" becomes a major contributor to their degradation.

2.6 Theoretical framework

Wetlands are regarded as productive and dynamic systems that support life through their services and important roles which they play (Finlayson *et al.* 1988). Their management is characterized by lack of clear policy formulation and implementation and in many cases conflicting roles in wetlands management. Importantly, knowledge of the location, distribution and character of wetlands, their values and uses, institutional and legal framework and challenges which is essential for effective management , is still required (Dugan, 1990; Finlayson *et al* 1988).

Development and population growth are claiming increasing shares of land for housing, industry and infrastructure. The major cause of land loss, however, is degradation. Population growth has caused excessive exploitation of resources. Though development should be conducted to satisfy the desire of growing population, the conservation of the environment must not be stopped. Ecosystems of all kinds are under pressure worldwide. Coastal and lowland areas, wetlands, native grasslands, and many types of forests and woodland have been particularly affected or destroyed. While forests decreased by about 5 per cent between 1980 and 1995, the rate of deforestation has been declining slightly (Food and Agriculture Organization of the United , 2000b). Urbanization will be one of the most important demographic trends of the twenty-first century. Indeed, virtually all the population growth expected during 2000-2030 will be concentrated in the urban areas of the world (United Nations, 2000c).

Population growth influences the spatial concentration of people, industry, commerce, vehicles, energy consumption, water use, waste generation and other environmental stresses (Bartone, Bernstein and Leitmann, 1992). Relatively rapid and uneven population growth and economic development are occurring simultaneously with degradation of aspects of the earth's physical environment.

Development works must satisfy the needs of the present generation without harming the requirement of the future generation.

Throughout the world many fragile, biologically unique ecosystems, and the many species of plants and animals they contain, are threatened.

The challenge is to identify the complex interactions and effects of population, environment and development. To date, while some progress has been made, this challenge remains formidable for researchers and policy makers alike. Sorting out the interactions among population, environment and economic development needs more and better data.

Population growth, structure and distribution are important aspects of environmental stress in so far as everyone requires the basic necessities of water, food, clothing, shelter and energy, which directly or indirectly affect the ecosystems (World Resources Institute, United Nations Environment Programme, United Nations Development Programme and World Bank, 2000) (united nations,2001) Human encroachment of natural areas stems from the demand for both residential space and agricultural production.

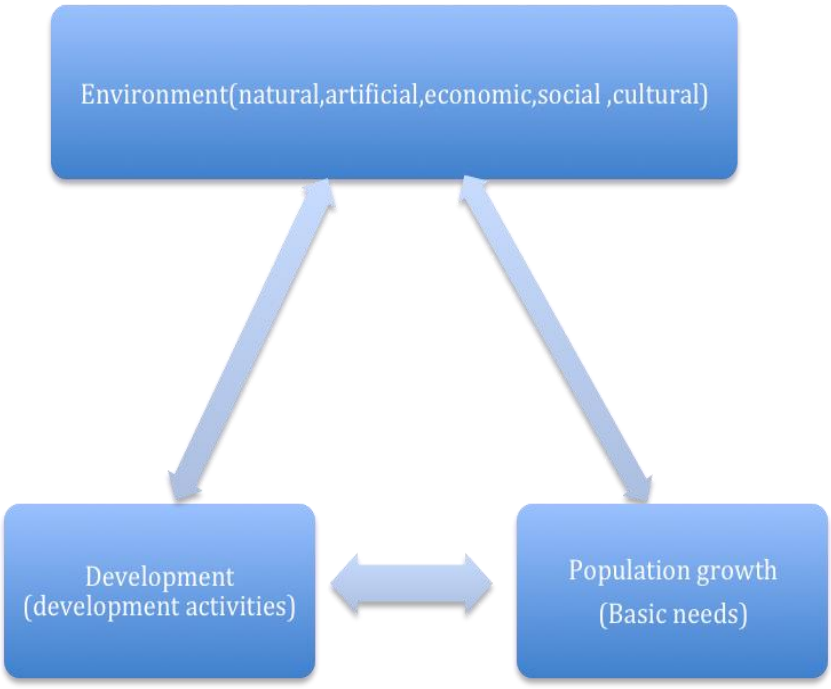


Fig 2-1: Theoritical framework on linkages between population, environment and development (Education for peace and security; Jibes 2012)

2.7 Conceptual framework

My conceptual framework is based on the fact that there is need for emphasis on strong institutional and legal framework in order to achieve sustainable urban wetland management and also involve and create public awareness on the values and roles played by wetlands and the need to protect and conserve them. Monitoring and evaluation should be conducted to assess efficiency of these laws and therefore, in so doing, the wetlands will be able to provide their ecosystem services sustainably to meet human needs in both the present and future generations.

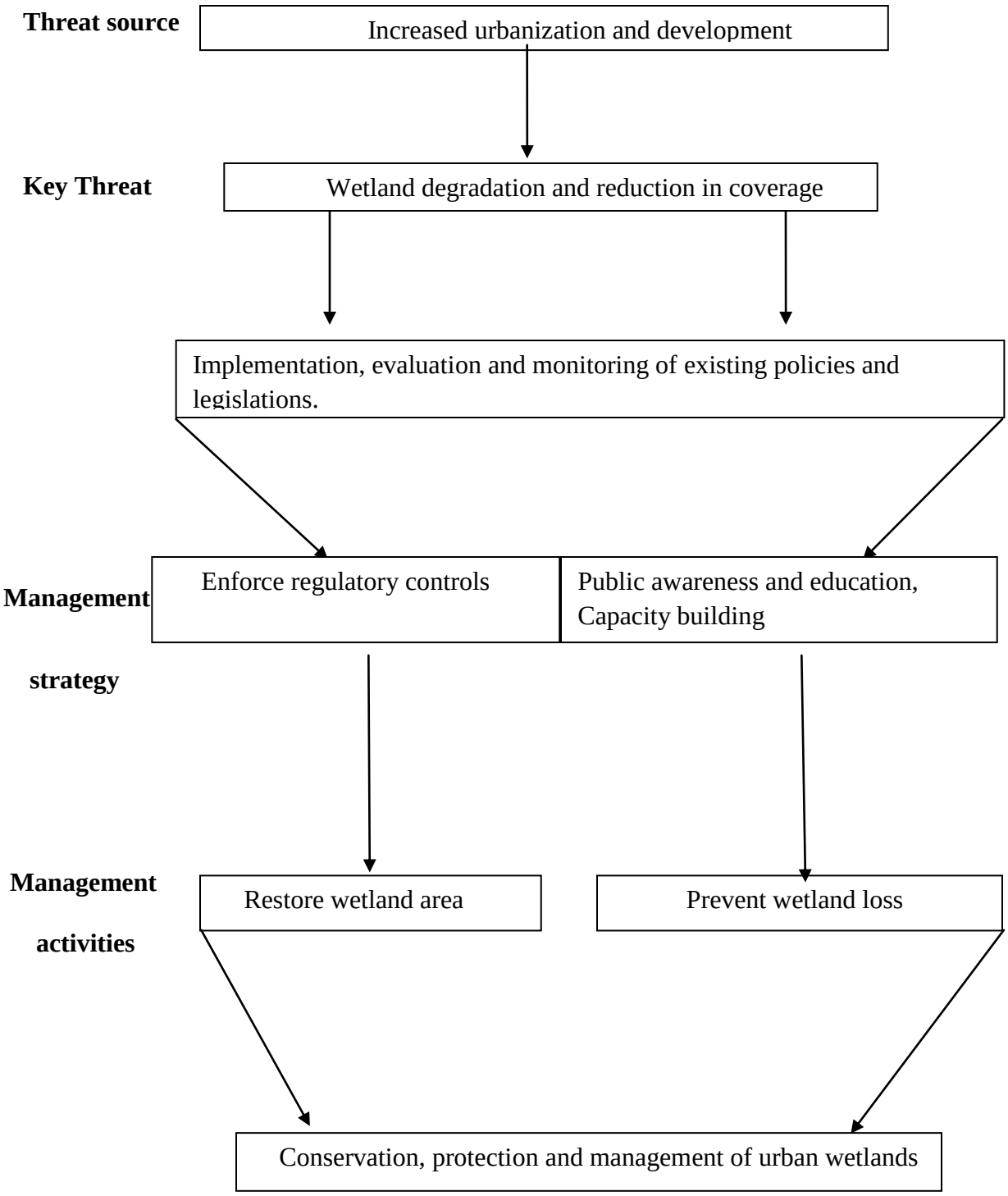


Figure 2-2: Conceptual framework (Researcher, 2014)

CHAPTER THREE: AREA OF STUDY

3.1 INTRODUCTION

This chapter comprises of the background information about Kangemi in terms of its location, physical set-up (topography, drainage, geology, soil and climate), economic set-up (agriculture, trade, commerce, tourism industries and transport) and its social set-up (demographics, population projections and population composition).

3.2 Physical set-up of the area of study

Kangemi is one of the six sub-locations which comprise Westlands Division. It lies in the Northern part of Westlands, adjoins Mountain View Estate at its eastern border and the Loresho South Estate to the North. On the south it borders Kawangware and on the west, Kabete which belongs to Kiambu county. Loresho and Kabete estates are high-class residential areas of the European and African elites, displaying a striking contrast to Kangemi. The total area of Kangemi is five square kilometers. Kangemi is one of the fastest growing residential areas in Nairobi.

At 1,795metres above sea level, Kangemi, in Nairobi, enjoys a moderate climate. The mean temperature for this area is 24°C. There are two rainy seasons but rainfall can be moderate. The cloudiest part of the year is just after the first rainy season, when, until September, conditions are usually overcast with drizzle. As Nairobi is situated close to the equator, the differences between the seasons are minimal. The area is served by 6 rivers namely, Thiboro, Watiti, Machagucha, Nyanjacuri, Kang'ora and Nyonduro. The rivers are permanent and they drain into the Nairobi River. They are recharged during the rainy seasons.

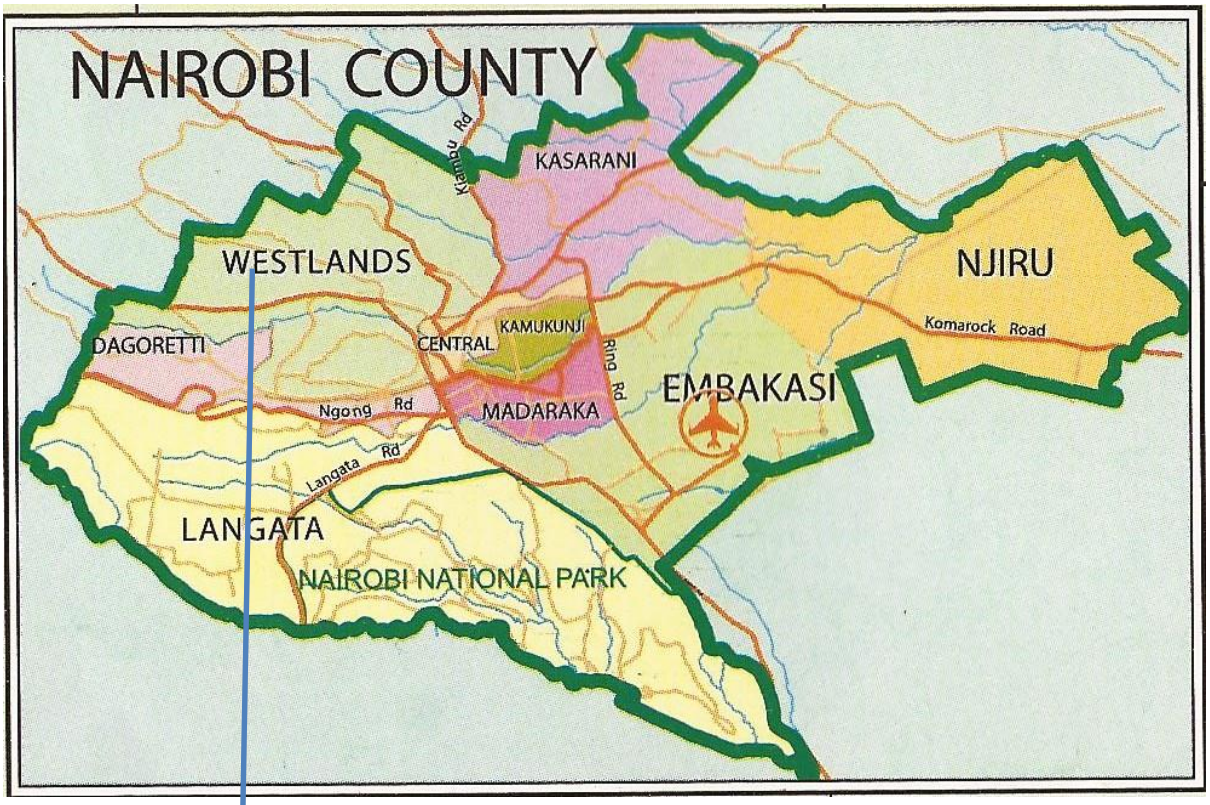


Figure 3-1: Map of Nairobi County

Source: http://commons.wikimedia.org/wiki/File:Nairobi_County.(2011)

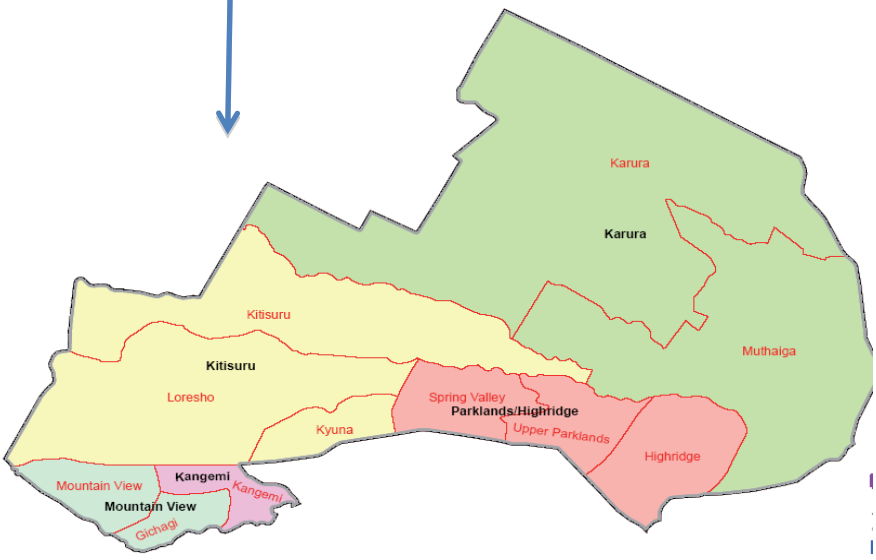


Figure 3-2: Map of Westland Constituency and County wards

Source: http://mudavadi2013.com/Nairobi/Westlands/Maps/Westlands_Map.PNG

Plate 3-1Aerial Photograph showing location of Watiti wetland

Source: http://www.osfea.org/images/2012/10/kangemi-resource-centre-map.jpg

Plate 3-2: Photograph showing part of Watiti wetland

3.3 Economical set-up of the area of study

Prior to the invasion of European planters, Kangemi was settled predominantly by the Kikuyu peasants who used to be engaged in agriculture, growing mainly sorghum and maize until Independence. With increase in population overtime came with the need for accommodation leading to development of tenant houses on the agricultural farms (Matsuda, 1984).

Kangemi area has a section of formal and informal settlements. The settlements are major contributors to pollution in the area due to garbage damping and injecting raw sewage in the rivers. However, some parts of the area are under small-scale agriculture such as Kabete, Thiboro and Kang'ora. A few households keep livestock and poultry. Some institutions like AHITI and upper Kabete of University of Nairobi and veterinary labs have livestock. Majority of the land is used as residential areas and also for businesses and institutions. The residents of this area have migrated from other parts of the country into Kangemi to seek for employment.

3.4 Social set-up of the area of study

According to the Kenya National Bureau of Statistics, Kangemi is estimated to have a population of 44,564 the youth estimated to be 36,691, which is about 80% of the population. The area has high residential developments due to the fact that there is more land for the growing population and the citizen's assumption for ownership of any free land and can therefore utilize it in any way.

Kangemi has both planned and unplanned residential area with the later having a high density residential area which is due to rezoning of various residential neighbourhoods to commercial and other institutional uses. The existing environmental problem in human settlement is as a

result of urban policies and which is further exacerbated by locating settlements on fragile land. Housing deficit has resulted in proliferation of informal settlements, construction of unauthorized extensions and poor standards constructing housing units. The informal settlements in this area have developed due to increase in urban population, high cost of land and land speculation, inadequate housing, lack of proper forward planning preciding actual development, declining modern sector employment and urban poverty among others.

It has three secondary schools and over five primary schools where students go to get education. These are not enough to accommodate the original number of students and as a result, the schools are congested and services strained.

The major healthcare centres are two with clinics scattered around Kangemi that cater for health needs of Kangemi residents.

3.5 Environmental and ecological set up

Rapid urbanization and industrialization in Kangemi not matched by timely planning and enforcement impacts on the rivers and natural ecosystem become quickly manifest and the situation continue to deteriorate (Ndede 2002). Raw sewage and waste from commercial activities and human settlements situated along and wetlands and rivers have turned the waters into sludge, causing health hazards and stress on the immediate aquatic ecosystems not to mention the downstream effect (Krhoda, 2002).

Kangemi has been subjected to serious environmental degradation mainly by the increase in population compounded by high poverty levels, demand for resources, unplanned development, pervading ignorance of environmental issues and general apathy and institutional failures.

The upper, middle and lower class individuals are involved in the development process. They all encroach on the wetland.

Most of the people in Kangemi live in informal and highly congested settlements and therefore, have encroached on the wetland and river reserve and have hardly any supporting sanitary facilities thereby causing considerable pollution. Sewerage network in Kangemi is grossly inadequate thereby causing illegal discharges of sewage into the rivers. The prevailing situation is completely unacceptable. What is unfortunate is the situation has continued unattended for decades (UNEP, 1999/2005; Kahara, 2002).

CHAPTER FOUR: RESEARCH DESIGN AND METHODOLOGY

4.1 Introduction

The research was aimed at identifying issues related with encroachment of urban wetlands, Watiti wetland in this case, by residential developments, other related effects alongside, and what is being done to ensure that wetlands in urban wetlands are protected and conserved for their value and functions. It is also important to bring into light data analysis strategies as well as ethical considerations applied during the research.

4.2 Research Design

The type of research design undertaken in this study is quantitative research that involves collection of quantitative data, which is any data in numerical form such as statistics and percentages. According to Allen, Tis worth and Hunt (2009) quantitative research is any approaches that use systematic observations intentional, replicable, and valid) to account for human behaviors and then generalize to the population. It involves administering a questionnaire and collecting a sample of numerical data from participants to answer the question and later n analyzing the data collected.

4.2 Nature and sources of data

To achieve the objectives of this study, both primary and secondary data were used. The primary data was collected from interviews with institutions, observations and administering questionnaires in households while secondary data used was from books.

4.3 Data collection instruments

4.3.1 Primary data

Primary data was collected in the course of doing research especially through surveys and direct communication with respondent. The methods used included;

- Interview schedules - The interviewee was asked different questions depending on the information needed through an interactive manner. The questions are asked and filled by the interviewer in a face-to-face situation with the interviewee.
- Questionnaires – researcher assisted questionnaire was used to include the high illiteracy levels of the sample population. The questionnaire contained several questions on wetland management and was administered to the selected households so as to have time to explain the purpose of the study and the meaning of the questions if they are not clear to the respondents.
- Focused Group Discussions – The data was collected from the Water Resource Users Association so as to get an in depth on dealing with issues concerning with wetland protection and management and also the way forward in ensuring their sustainability.
- Observation- this was used to measure the overt behavior of persons and the environment and it covered the subject to be observed, the length of observation, behavior to be observed and recording of observed changes.
- Photography – it was used to show the area of study in a clear way and also show the anthropogenic activities taking place and their contribution to the reduction of the wetland area.

The sources provided data on stakeholders, threats, degradation trends and management options currently available in the wetland and the environmental stress factors.

4.3.2 Secondary Data

The study also made use of existing information, including published and unpublished data. The data was obtained from topographical map and satellite imagery that was useful in mapping the extent of encroachment on the Watiti wetland and geographical borders of Kangemi ward. Locating the sources and retrieving the information of such data was deemed as a good starting point to establish what has already been done and to what extent. The source included Literature review on relevant library material, earlier research journals, periodicals, the media and the Internet.

4.4 Population description

In order to achieve the objectives of the study, the target population consisted of government agencies and Community Based Organizations (CBO's), individuals and household who had interest in the Watiti wetland and river in various ways like farming. This individuals and groups were interviewed and their views were included in the report on their take on urban wetland management.

4.5 Sampling methods

Simple random sampling procedure was employed in data collection. The sample size consisted of Thirty-Nine who live around the wetland and those who have encroached on the wetland.

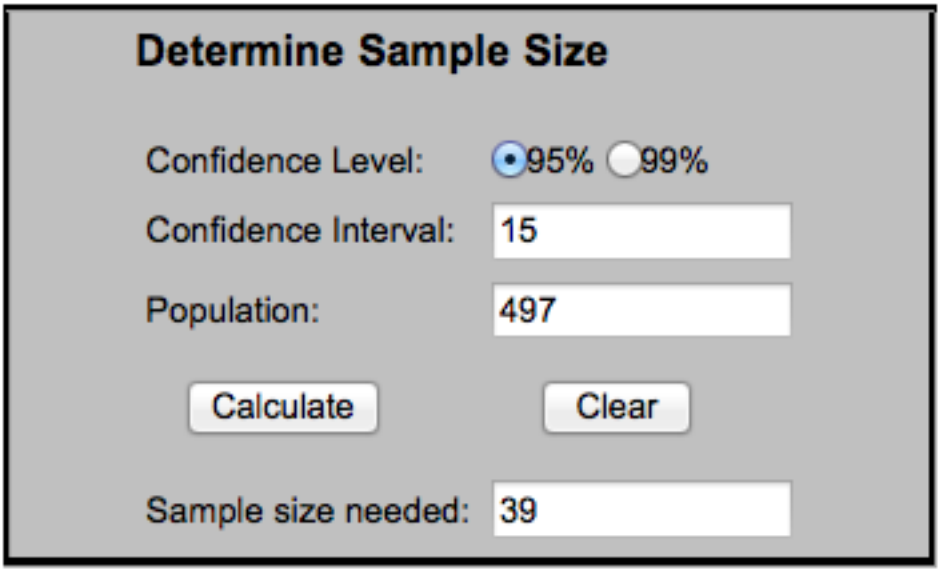
The sampling procedure was conducted under the assumption that there was no replacement. The researcher visited the area, Watiti Area, and identified households living around the wetland. The

population (N) was identified as 497 households and the same were numbered to allow for easier random sample selection.

Those households responsible for urban wetland management constituted the sample frame. The sample procedure and technique involved choosing of households randomly, by chance, and without replacement. The aforementioned was aimed at ensuring that individuals randomly and entirely by chance, such that each individual has households the same probability of being chosen at any stage during the sampling process.

A simple random sample is a sample of size *n* drawn from a population of size *N* in such a way that every possible sample of size *n* has the same chance of being selected.

To determine the sample size the research utilized an automated sample size calculator. The researcher keyed in the necessary data and a favorable sample size of 39 households, from a possible 497 households that were counted and which were found within the edge of the wetland, that is, households that had encroached on the wetland and households surrounding the wetland. The researcher then randomly selected the households at intervals of approximately 12 households till the required number (39) was satisfied. The picture below illustrates the process of calculating the sample size.



Source: http://www.surveysystem.com/sscalc.htm Retrieved on 28/04/2014

Purposive sampling was employed since the researcher is allowed to select a sample which serves his/her purpose. The sample is selected because they are informative or they have the required information. Purposive sampling was used in the study of different institutions and organizations dealing with management of urban wetlands. Only those institutions whose spheres of responsibility are related to management of urban wetlands were sampled

4.7 Data analysis

Once the data is collected from respondents, the next step is to sort the data by organizing both coded and random data into categories that best serve the purpose of the study, do appropriate statistical analyses, interpret the data, and make recommendations pertaining to the research objectives. In addition, data were analyzed using descriptive statistics representing pie charts and bar graphs, organized. Quality control check as a control strategy was used in this research to ensure all data collected was important and relevant.

CHAPTER FIVE: DATA ANALYSIS, DISCUSSIONS AND PRESENTATION

5.1 Introduction

This chapter presents the findings of the study and attempts to answer the research questions posed by the study at the outset. The main purpose of the study was to identify the impacts of residential development on Watiti wetland, the contribution of the institutions and local community on management of the wetland and the measures taken to deal with the issue of concern. The study further aimed at administering of questionnaires to individuals living around the wetland and also interviewing the institutions charged with the responsibility of managing urban wetland.

5.2 Policy and Legislation

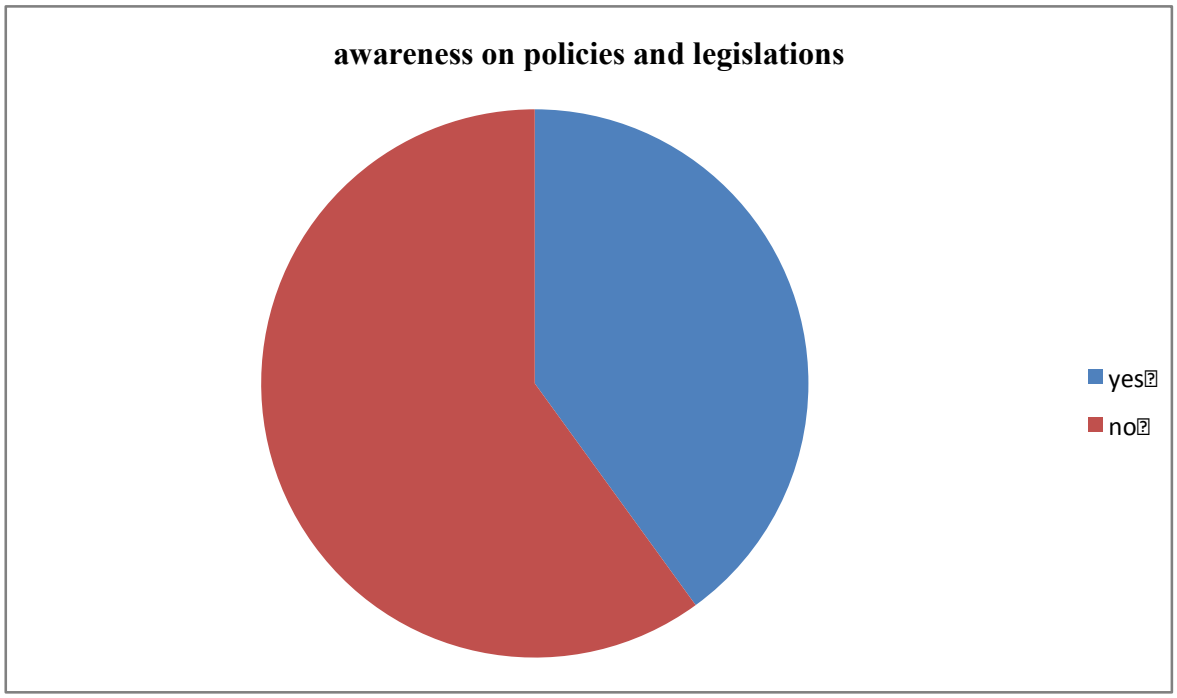


Figure 5-1:Awareness level on existing policies and legislations dealing with wetlands

The lack of policies and legislation awareness and information that deal with wetland management is a challenge in trying to protect and conserve the Watiti wetland as depicted in the study. A majority agree that they are not conversant with set policies and legislations on wetland management. Those aware quoted the EMCA 1999, building code and physical planning Act. The institutions that were interviewed agreed that there was lack of public awareness on existing policies and legislations and also the implementation bit from the policy makers was also an issue.

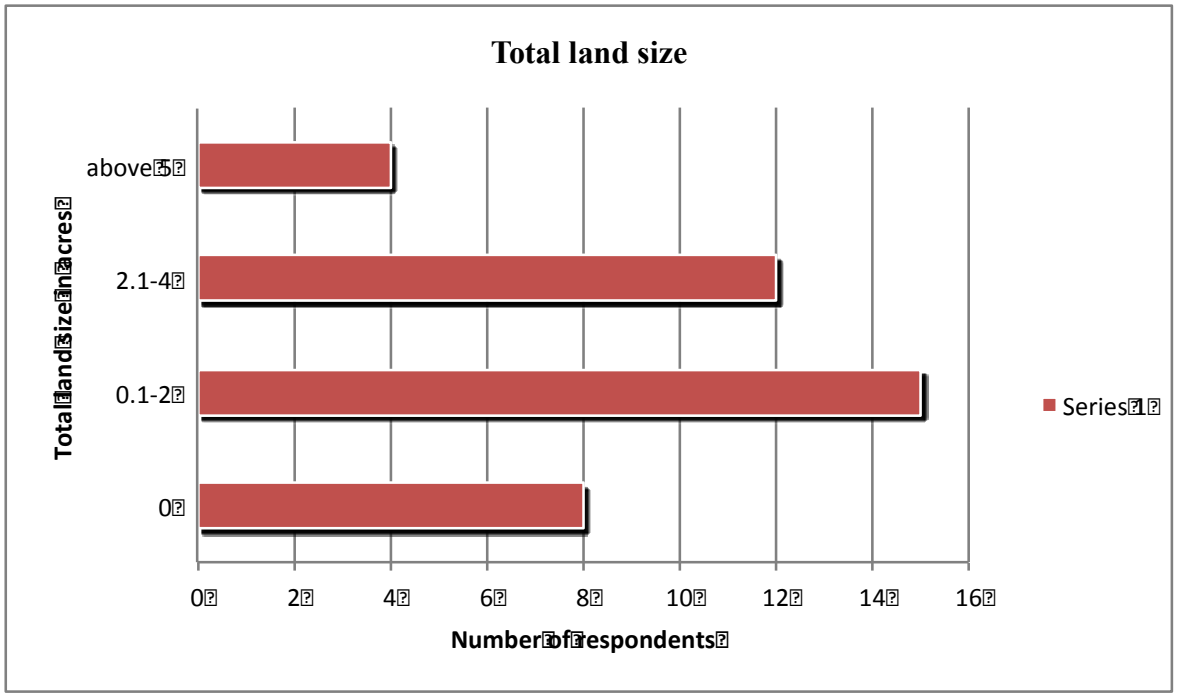


Figure 5-2: Total land sizes of respondent

5.3 Land Tenure system

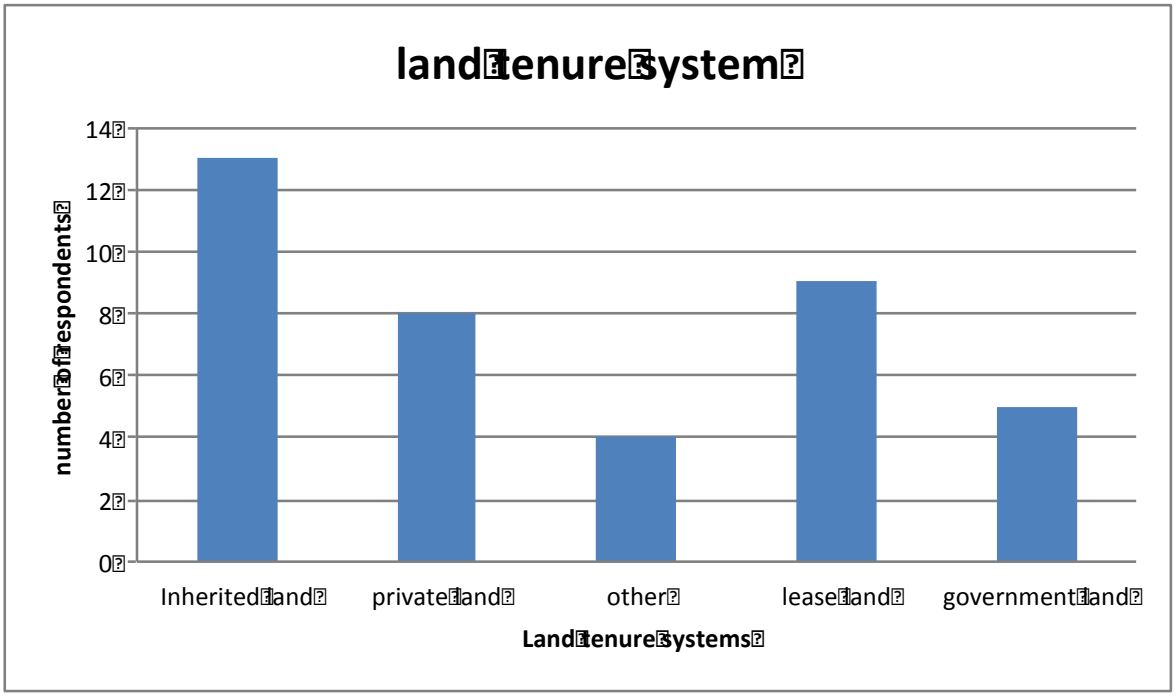


Figure 5-3: Land tenure system in the area of study

A majority of the respondents were born in this area therefore accounting for the higher percentage of land ownership through inheritance around the wetland. This attributes to increased encroachment due to demand for more land for the increased population over time leading to degradation of the wetland ecosystem. It is also as a result of population pressure and the resulting tendency of people to move to what is perceived as free land.

5.4 Anthropogenic activities

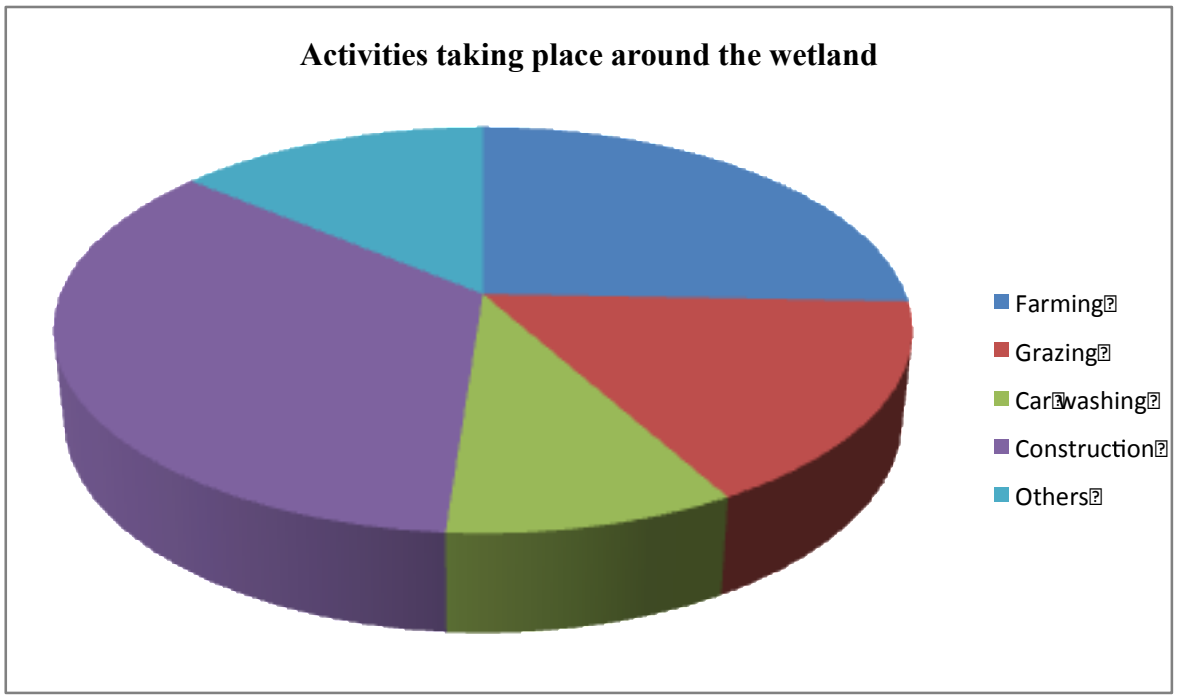


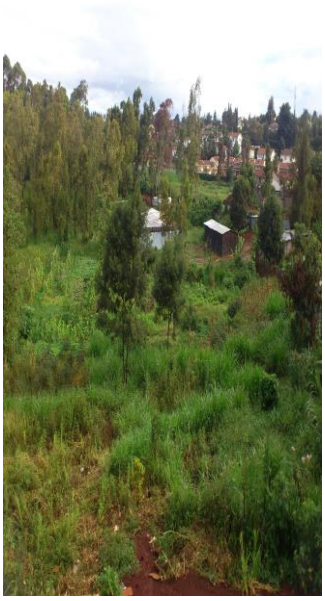
Figure 5-4: Activities taking place around Watiti wetland

According to the study, farming, grazing, car washing and construction were the main activities taking place and that were encroaching the wetland. Due to population increase and demand for basic human necessities such as food and shelter, residents encroach on these wetlands to provide more land for agriculture and housing. The threats facing the wetland ecosystem include: establishment of new human and livestock settlements in wetland areas and cutting of aquatic and other vegetation for fuel, housing and commercial activities. These threats have induced changes that have eroded the ecological and socio-economic values and services derived from wetlands. Drainage and reclamation of wetlands for agricultural development, human settlement and industrial development is one of the biggest threats to wetland conservation and management.

Increasing human populations and change from subsistence to commercial exploitation of wetland resources continue to exert increasing pressures on limited wetland resources, resulting in a decline of services and quality as well as quantity of products derived from wetlands.

The quality of many water sources in Kenya is declining as a result of agricultural and industrial wastes/ discharges. These have negatively impacted water quality and biodiversity within the wetland ecosystems thereby reducing their values. Increased nutrient loads have led to eutrophication and episodes of algal blooms in wetlands near major settlements. In certain areas excessive abstraction of fresh waters, diversions, and catchment degradation, have led to increased salinity. Car washing is also another activity through which individuals earn their living and this leads to wetland degradation. Other activities that are also carried out include logging and charcoal burning.

Table 5-1: Effects of Anthropogenic activities on Watiti wetland

Activity	Effects	Illustration
Farming	✓ Degradation of wetland biodiversity and decline of soil fertility through fertilizer and pesticide application. ✓ Diversions reducing the flow of water into the wetland and water quantity ✓ Soil erosion which leads to siltation of Watiti River ✓ Pollution inputs through runoff and leaching of pesticides and toxic substances	 Plate 5-1: Farming in the wetland
Grazing	✓ Disturbance of soil by cattle movement increases surface flows leading to soil erosion ✓ Animal waste as a pollution input through surface runoff ✓ Disturbance and alteration of vegetation during cattle movement	

Car washing	✓ Detergents used provide nutrients for algae to bloom causing proliferation ✓ Oil spills lead to reduction of oxygen leading to loss of aquatic life found in the wetland	 Plate 5-2: Car washing area
Construction	✓ Leads to elimination of habitat used by fauna ✓ Loss of large areas of productive wetland ✓ Hydrologic alterations lead to concentration of pollutants and reduce the capacity of wetland to remove pollutants ✓ Reduction of flood storage capacity	 Plate 5-3: Ongoing constructions
Lumbering and charcoal	✓ Deforestation leads to soil erosion. ✓ Habitat loss for fauna found in the	

burning	wetlands	

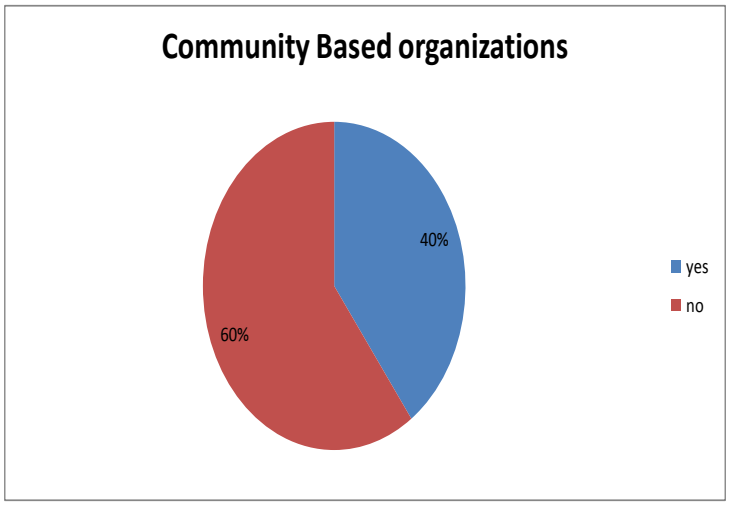


Figure 5-5: Existing Community Based Organization and Public Participation

From the research, 60% of the respondents were not aware of any existing Community Based Organizations that deal with protection and conservation of urban wetlands. The groups mentioned included the WRUA that ensure wetlands are well protected and conserved including the rivers and the Inua Youth Group that also ensure biodiversity well protected.

5.5 Intervention measures

The conservation and management of wetlands have to be considered in a broader context of integrated and sustainable natural resource planning and management.

The respondents admitted to nothing being done to ensure protection of the wetland but on the other hand the responsible groups have proposed ways to go about in the protection of the Watiti wetland. These include;

1. Fencing of the Watiti wetland to ensure that the public does not encroach on the wetland.
2. Construction of sewerage systems to prevent pollution of the Watiti wetland and river
3. Regular monitoring and inspection of activities pertaining to the usage of the Watiti River and wetland to prevent degradation and pollution.
4. Development of a Sub-Catchment Management Plan that will ensure that the urban wetland is protected and conserved for sustainability.
5. Creation of public awareness on the values and roles of wetlands and the importance of their protection and conservation.
6. Strengthening of institutional capacity on conservation and management of wetlands and enhancing and maintaining functions derived from wetlands in order to maintain ecosystem goods and services.

5.5.1 Water Resource User Association

A Focused Group Discussion was held and members of Thiwama WRUA were interviewed on issues associated with Watiti Wetland and their views on wetland management.

Thiwama WRUA is a voluntary membership association made up of water users and riparian landowners in Kangemi, Westlands District. The WRUA was formed and registered in the year 2009 with the registrar of societies.

Wetlands being under threat have seen the development of community based water resource users associations known as WRUAs that are made up of voluntary membership from riparian landowners and water users interest in the proper management of the wetland.

Their main objective is to ensure that wetlands are protected and channel the desired stakeholder participation in a way that helps to address some of the problems that have led to wetland degradation for example low level of awareness, poor land and water use practices, low levels of compliance with regulations, lack of proper monitoring among others.

Encroachment of Watiti Wetland is due to population pressure in Kangemi and the land here is being sold for building residential flats. This in time will lead to drying of Watiti River.

The measures that have been put forward to protect the wetland include: afforestation and reforestation, riparian marking and conservation activities. They have also come up with a Sub-Catchment management Plan that incorporates issues arising about wetland degradation and measures to be taken to conserve the wetland.

CHAPTER SIX: SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

6.1 Summary of findings

- Encroachment of residential development on urban wetlands has adverse impacts on it. It contributes to the degradation of the wetland environment and reduction of area coverage of the Watiti wetland and reduction in water quantity. There is loss of biodiversity during the clearance of vegetation to pave way for residential developments.

- The existing policies and legislations on wetlands and objectives aimed at enhancing and maintain functions and values, protect biodiversity and improve essential processes and life support systems have not been met. Creating of public awareness on values, roles and importance of wetland management should be capitalize on

- The partnership and contribution of CBOs and local communities is of essence in the management of the Watiti wetland. Involvement of the public in wetland management ensures that they value the importance, benefits and functions of wetlands.

6.2 Recommendations

1. Wetlands are fragile ecosystems, which provide multiple ecological and socio-economical products, services and functions. They need an integrated approach to their planning and sustainable use. The Ministry of Environment, Water and Natural Resources in conjunction with NEMA and the County Government can formulate Policies and technical tools that are needed to counteract lack of appropriate information and intervention failure that cause wetlands to be used in an unsustainable way.

2. Community outreach and education program among the various stakeholders in order to enhance increased awareness and knowledge on the importance of wetlands and the impacts of residential developments on them. Education and public awareness is essential to create commitment and positive attitudes towards conservation and sustainable utilization of wetland resources. NEMA and the various CBOs and NGOs can sensitize local communities on wetland management since they are closer and can associate well with the local people.

3. The Ministry of Environment should work together with the Ministry of Lands and the County Government to provide a secure land tenancy system whereby the riparian areas should be clearly mapped and those living near this area should have legal title deeds. This will enhance conservation of the Watiti wetland. Regulation, protection, management and conservation of wetlands within public, private and community land is of essence.

4. The County Government should advocate for zoning measures to be put in place for Watiti wetland reserve and strict protection measures to be enacted for both the wetland and Watiti River.
5. The Central Government should recognize existing urban wetlands and that the designation of Wetlands Importance provides just the starting point for securing the sustainability of wetlands and the maintenance of ecosystem services, and that development and implementation of a management planning process, involving all stakeholders, is necessary to achieve this.
6. While wetlands play a role in reducing pollutant levels of inflowing water, they also require protection as water resources. The Watiti wetland receives untreated runoff from much of the developed urban area. The Nairobi City Council should advocate for use of

water quality standards that will go a long way in protecting the wetland from such inputs and also manage both solid and liquid waste.

7. The Ministry of Environment, Water and natural resources and NEMA should work with Survey of Kenya Institute of Survey and Mapping to monitor wetlands overtime since it is important to assess its functioning and maintaining wetland integrity. This can be done through mapping which is an effective tool for monitoring wetlands. Use of Remote sensing technology has shown to be an excellent source of data when mapping and monitoring smaller wetland habitats and vegetation communities.
8. NEMA should ensure that any drainage, conversion, burning, alteration of a wetland, or introduction of alien and invasive species in a wetland will be subjected to approved standard procedures including Environmental Impact Assessment (EIA), Strategic Environmental Assessment (SEA), Cost Benefit Analysis (CBA), and adequate public participation.

REFERENCES

Davidson, N. (2004). *Wetlands and human well being: the outcomes of the Millennium Ecosystem Assessment and the Ramsar Convention*. Ramsar Convention Bureau: Gland, Switzerland

David, T. (1994). *The Ramsar Convention Manual: a Guide to the Convention on Wetlands of International Importance*. Ramsar Convention Bureau: Gland, Switzerland.

DCM (2007). *Wetlands: Their Functions and Values in Coastal North Carolina*. Morehead City: DCM Printers.

Finlayson, C. *et al* (1999). Global Review of Wetland Resources and Priorities for Inventory: Summary Report in Global Review of Wetland Resources and Priorities for Inventory, (Eds. C. M. Finlayson and A.G. Spiers). *Supervising Scientist Report No. 144*, Canberra

Finlay, C. *et al* (2002). *A Manual for an Inventory of Asian Wetlands*. Kuala Lumpur: Wetlands International Global Series 10.

Finlay, C *et al* (1988). *Wetlands of Northern Territory. (Eds. A.J. McComb & Paul .S). Lake the Conservation of Australian Wetlands*. Sydney: Surrey Beatty & Sons.

GoK (1999). *Sessional Paper No.6 of 1999 on Environment and Development, Ministry of Environmental Conservation*. Nairobi: Government printers.

Issaias, I. (2002). *Environment Impact of Urbanization on Water Resources-A case Study on Nairobi dam*. London: Imperial College of Science, Technology and Medicine University of London.

Izak Walton League of America, Save our Streams Program. (1998). *Handbook for Wetland Conservation and Sustainability, second edition.* (Z. Hockins, Ed.) Gaithesburg MD.

Jon Kusler, P. a. (1996). *Our National Wetland Heritage: A Protection Guide*

(second edition). Washington D.C: The Environmental Law Institute .

Judith, A. (2007). *Watersheds: Values of Wetlands*. Carolina: NCSU Group.

Knopf, W. A. (1985). *Wetlands: Aubudun Society Nature Guide.* New York,NY.

National Research Council. (1995). *Wetlands: Characteristics and Boundaries.* Washington D.C: National Academy Press.

Tiner, R. W. (1998). *In Search of Swampland: A wetland sourcebook and field guide.* NewYork Brunswick. NJ.: Rutgers University Press.

UNEP (2005). *Millennium Development Goals Needs Assessment Report Requirements for Goal No.7, Target! 0: Providing Sustainable Water and Sanitation Services*. Nairobi: UNEP

United States Fish and Wildlife Service. 1983. *Pocosins: A Changing Wetland Resource* . US Department of Interior. FWS/OBS-83/32.

World Resources Institute (1995). *Millennium Ecosystem Assessment. Ecosystems and human wellbeing: Wetland and Water synthesis*. Washington: WRI

APPENDICES

KENYATTA UNIVERSITY

DEPARTMENT OF ENVIRONMENTAL PLANNING AND MANAGEMENT

Stella Nyasuguta Guto is a final year student taking a bachelor degree in Environmental Planning and Management. According to the school curriculum, she is required a research project as a part of training and development of skills and her research topic is on "Impacts of Encroachment of Residential Development on Urban Wetlands". The study will aim at identifying the effects of encroachment among other contributors of wetland degradation on Watiti Wetland, to examine existing institutional and policy frameworks and to recommend ways of protecting and conserving the wetland to ensure its sustainability. We therefore request you to provide her with relevant information, which will be used specifically for academic purposes. Thank you.

HOUSEHOLD QUESTIONNAIRE

1. Household Head's Name

   ……..

   Respondent's Name

   ……..

   Relationship of respondent to household head

   …….

2. How long have you lived here?

   0-4years ☐ 5-9years ☐ 10-14years ☐

15-19years ☐ Above 20years ☐

3. Which of the following land tenure system do you own?

   Inherited land ☐ Private ☐ Lease ☐ Government ☐

   Others ☐

4. What is the size of your land? ……. acres

5. What are some of the activities taking place around the area and their effects on the Watiti Wetland?

	Mark appropriately	Effects
Farming		
Grazing		
Car washing		
Construction		
Others (specify)		

6. What are some of the benefits derived from the Watiti Wetland?

……

……

……

……

……

7. Do you know of any existing policies and legislations that deal with management of wetlands?

   Yes ☐ No ☐

   If yes, state

   ……

   ……

   ……

   ……

8. What measures have been taken by the public to ensure that the Watiti wetland is well protected and conserved?

   ……

   ……

   ……

   ……

9. Are there any existing groups that deal with protection and conservation of urban wetlands?

   Yes ☐ No ☐

   If yes, mention and give their mandate

   ……

   ……

   ……

   ……

   ……

   ……

10. In your opinion, what do you think should be done to conserve the Watiti Wetland?

    ……

    ……

    ……

    ……

    ……

    ……

KENYATTA UNIVERSITY

DEPARTMENT OF ENVIRONMENTAL PLANNING AND MANAGEMENT

Stella Nyasuguta Guto is a final year student taking a bachelor degree in Environmental Planning and Management. According to the school curriculum, she is required a research project as a part of training and development of skills and her research topic is on "Impacts of Encroachment of Residential Development on Urban Wetlands". The study will aim at identifying the effects of encroachment among other contributors of wetland degradation on Watiti Wetland, to examine existing institutional and policy frameworks and to recommend ways of protecting and conserving the wetland to ensure its sustainability. We therefore request you to provide her with relevant information, which will be used specifically for academic purposes. Thank you.

INSTITUTIONAL QUESTIONNAIRE

Name of institution

……

Name of interviewee

……

Position

……..

1. When was the institution established and what is its mandate?

2. a) Does the institution have any policies in regards to management of Urban Wetlands?

   ☐ Yes ☐ No

   b) If yes, what are these policies?

3. a) Are you aware of any policies and legislations for the protection of wetlands?

   ☐ Yes ☐ No

   b) What is the contribution of existing policies and legislations on environment towards protection and conservation of urban wetlands?

4. a) What are factors constraining effective management of urban wetlands?

   b) How can the above constraints be mitigated?

5. What are some of the benefits/values of urban wetlands?

6. What do you think are the measures that can be put forward to ensure that urban wetlands are protected and conserved?

KENYATTA UNIVERSITY

DEPARTMENT OF ENVIRONMENTAL PLANNING AND MANAGEMENT

Stella Nyasuguta Guto is a final year student taking a bachelor degree in Environmental Planning and Management. According to the school curriculum, she is required a research project as a part of training and development of skills and her research topic is on "Impacts of Encroachment of Residential Development on Urban Wetlands". The study will aim at identifying the effects of encroachment among other contributors of wetland degradation on Watiti Wetland, to examine existing institutional and policy frameworks and to recommend ways of protecting and conserving the wetland to ensure its sustainability. We therefore request you to provide her with relevant information, which will be used specifically for academic purposes. Thank you.

FOCUSED GROUP DISCUSSION

1. When was the group formed and why?

2. What is their contribution to the management of the Watiti Wetland?

3. What are some of the anthropogenic activities that are carried out around the Watiti wetland and impacts that have been observed?

4. What are some of the policies and legislations that are used to ensure effective management, conservation and protection of the wetland? .

5. Are there measures that have been put forward to protect and conserve the Watiti Wetland?

6. What benefits/values are derived from the Watiti Wetland in relation to Kangemi residents and the Watiti ecosystem?

7. What major challenges do you face in trying to protect and conserve the Watiti Wetland?