UNIVERSITY OF NAIROBI

PROJECT TITLE: AN EVALUATION OF MANAGEMENT PRACTICES ON WETLANDS AND RIPARIAN RESERVES: THE NAIROBI DAM EXPERIENCE

BY

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DECLARATION

I NJUE GICOVI NJIRU declare that this research project is my original work and has not been presented for award of degree in any other University.

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GOD BLESS YOU ALL.

DEDICATION

To Mum, Dad, bro, and my sisters

To the late Kabogo &Jennifer and Masimba &Wanjambura

To all my friends

GLOSSARY OF ACRONYMS

D.D.T -Dichlorodiphenyltrichloroethane

E.I.A - Environmental Impact Assessment

E.M.A.S - Environmental Management and Audit System

E.M.C.A -Environmental Management and Coordination Act (of 2000)

EPA - Environmental Protection Agency

F.O.N.A - Friends of Nairobi dam Association

GoK - Government of Kenya

H.A.B.R.I - Housing and Building Research Institute

I.S.O - International Organization of Standards

K.W.W.G - Kenya Wetlands Working Group

LDC's -Less Developed Countries

N.E.A.P -National Environmental Action plan

NCBD - Nairobi Central Business District

NCC - Nairobi City Council

NEMA - National Environmental Management Authority

NGO -Non Governmental Organization

NRBP -Nairobi Rivers Basin Initiative

U.O.N -University of Nairobi

U.S -United States (of America)

UN -United Nations

UNDP - United Nations Development Programme

UNEP -United Nations Environmental Programme

WRI -World Research Institute

WRMA -Water Resources Management Authority

ABSTRACT

Urban environment management has been recognized as key factor in the sustainable development of urban settlements that support the lives of its resident and provide them with the basic requirement of food, shelter and water. Of concern to this study were urban wetlands. The study sought to find out the adequacy of wetland management in Kenya and used a case study of the Nairobi dam.

The literature reviewed revealed that management is key to the existence of wetlands in the human scope and Kenya needs a proper land use plan that factors in the needs of conserving wetlands from pollution, encroachment, clearance and for sustainable existence of wetlands.

In recognition of the importance of natural resource, the study sought to look at the current stakeholders who are engaged in the management of wetlands and Nairobi dam in specific.

After their recognition, it was of importance to find out their involvement and modes of management in the wetland identified above. To collect this information two sets of questionnaires were administered; to government officials, and to the nearby area residents. Other methods employed included interviews, informal discussions, observation and physical visiting of site to identify its status of result achieved by the stakeholder management practices.

According to this study, Kenya has put up many planning and legal measures to curb settlement within environmentally fragile areas such as riparian reserves and wetlands.

But least of these is wetlands and thus questions raised are to advocate for the sustainable management of natural resources as well as water resources linked to riparian resource area that are water body encroachment buffers.

The study found out that, for effective management of wetlands, commitment by the GoK has to be effected on wetland management through funding management objectives, enforcing environmental law and reviewing wetland related sections of these statutes. Local community engagement in protection of the dam was also found to be lacking. The study also found out that actual management of the dam was non existent and it was of most importance to note that the dam water was virtually invisible..

The study hence recommends the overhaul of the management of wetlands from administrative bodies to stakeholder involvement, with formation of a channel of communication between stakeholders for even flow of energy in management.

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CHAPTER ONE

INTRODUCTION

1.0 Introduction

Wetlands are internationally defined as areas that are predominantly, seasonally or permanently water logged with fresh, saline, brackish, or marine waters including manmade and natural areas that support a characteristic biota. This definition applies to Kenya as well with examples being swamps, rivers and lakes. A riparian zone is defined by its spatial relation to being adjacent to other aquatic habitats such as lakes, reservoirs, intermittent streams, springs, seeps, and wetlands (**Regional Wetlands Biodiversity Group, 1996).** Riparian reserves are designated in plans as preferred management areas for wetlands.

In urban areas, development of the areas around economic activities leaves land of least value least unappreciated (Kingoriah, 1987). Kingoriah (1987) tries to envision wetlands to be part of that land that cannot be used for settlement, industrial or commercial purposes. Wetlands are under this category as they tend to be periodically unusable hence their perception as land of least value. Ironically wetlands have been perceived as wastelands associated with disease, difficulty and danger. Emphasizing the negative impacts and ignoring their importance, these habitats were considered obstacles in the path of progress and hence drained, filled, despoiled and degraded for alternative economic gains. The wetland loss has been responsible for bringing to the verge of extinction countless species of plants and animals. This is a result of the capitalistic approach in Kenya's urban economic landscape. This research operates on the premise that once a wetland has been significantly damaged or modified, it can rarely if ever be returned to its original state. Some of the intrinsic and/or extrinsic values lost may be irreplaceable. Wetlands contribute benefits that are not appreciated until they have gone. Possible future benefits may not be recognized at the time of development.

Areas around wetlands have been engaged in planning to provide for areas where their expansion can be catered for and to allow for their seasonal variations.

Due to these rising concerns on wetlands management and conservation, the issue raised is; are the relevant stakeholders carrying out management practices and how effectively are they performing.

This study uses wetlands, and riparian reserves to mean areas that are seasonally a subject to water logging, as a result of the hydric soils present in these areas.

Management, on the other hand, is the interplay of stakeholders and resources in dealing with a subject matter that is geared towards perpetuating efficient utilization and/or exploitation of the aforementioned subject matter.

In the words of Environmental Protection Agency (EPA), human invasive nature and environment passive nature tend to conflict, with the former taking an upper hand. In the case of the Nairobi dam, there have been prompting media and United Nations Environmental Programme reports on human indulgences that have resulted in unfamiliar and persistently peculiar environmentally hazardous occurrences. Although wetlands are providers of many products and services, and there are reciprocal impacts between humans and wetlands, wetlands management has often been uncoordinated, with only a few commercial objectives being emphasized. Fringe wetlands near lakes and rivers are among the least investigated aspects of these ecosystems.

The biodiversity in the wetlands is at risk from habitat destruction and degradation and this is a key issue that has attracted World Research Institute (WRI) onto producing periodic reports with the 2000 report touching on East Africa's biodiversity's base as one that is regarded highly under risk. It's in the policy concerns that wetlands are thereby placed under strict observation that can give them a chance to co-exist with today's pressures posed by human activities. In the scope of environmental hazards the human settlements around these wetlands, there has been increased vulnerability to threats posed by nature to the oblivious people settling on riparian reserves and areas designated for wetlands. While there are government institutions (e.g. ministries, departments, curriculums/programmes) dealing with fisheries, these institutions operate independently of others, for example, those dealing with water as a resource. In many countries, there are departments dealing with agriculture, water and forestry, but there are no equivalent institutions dealing with this sensitive area of wetlands.

1.1 Problem Statement

Wetlands are rapidly disappearing. Lack of proper management systems and uncontrolled human manipulation such as reclamation of wetlands and clearing of wetland catchment areas for agriculture, industry, and human settlement may be the root cause of this problem (UNDP, UNEP, WORLD BANK and WRI REPORT, 1998).

There seems to be a general concern for the deteriorating conditions of wetlands in general, but these concerns are limited to individuals and institutions as they go about their individual businesses (Kenya Wetlands Forum, 2006).

Various studies have been conducted and recommendations made in East Africa over the existing conditions and threats of wetlands in the region with policies drafted and forums set up. The challenge is; are the current stakeholders managing wetlands able to maintain and improve the quality of wetlands effectively under the growing and increasing population and subsequent pressure on land set aside for riparian areas. This is in light of the collapse of the Kenya Wetlands Working Group (K.W.W.G) and the formation of the Kenya Wetland Forum where University of Nairobi is a member. This research looks into the various parties involved, their roles in managing wetlands, and the methods they have employed this far with a view of recommending ways of improving wetland management.

1.2 The Objectives of the Study

The study sought to;

i. Identify and list the various stakeholders involved in the management of the dam.
ii. Identify existing management practices of the above stakeholders on the dam.
iii. Identify the constraints, if any to the existing management practices.
iv. Suggest possible ways of overcoming any constraints identified.

1.3 Hypothesis

Lack of adequate management is the cause of the current state of the dam.

1.4 Scope of the Study

Due to the limitation of the available financial and time resources, the research was confined to the dam only. The study limited itself to local residents, opinion leaders' government officials and members of the local authority and NEMA.

According to the U.S. Northwest Forest Plan, riparian reserve for permanent water bodies like in the case of Nairobi dam that spans three square kilometers, the established reserve should not be less than two tree heights or three hundred feet of each bank. i.e. 91.44 metres.

- In this respect, the physical width of the wetland identified (the dam) to be studied and the human activities was limited to ninety (90) metres of the bank of the case study.
- The study also confined itself to the extent of the areas for settlement, under economic activities.
- The study was limited to management theories/ principles directed to wetlands.

The case study was selected due to its proximity to an area with a high capitalistic base that in the recent growth seems to cloud beneficial aspects of managing wetlands for a benefit of the whole society.

Its proximity to areas of high residential density in the wake of population boom in urban areas in Nairobi over the last thirty five years is piling pressure on the management and conservation of these areas (UN report on population, 2002)

1.5 Research Methodology

The research used a case study that enabled carrying out of the fieldwork that allowed identification of study issues on the ground. The research used key informant interviews. The study analyzed and used both primary and secondary sources of data.

1.5.1 Primary sources

Primary data was obtained through semi-structured interviews that were administered to key informants in N.E.M.A, government offices, residents on the dam peripheries, neighbourhood opinion leaders (e.g. Nairobi sailing and sub aqua club) within the area of study.

Structured questionnaires were administered randomly to the households, established on and around the areas under investigation, the Nairobi city council and the national environmental management authority. Physical examination and observation of the area under study was undertaken, to assess the visible elements of management around the area of study. This was instrumental in collecting relevant information to prove the management aspects of the dam for the purpose of this study.

1.5.2 Secondary sources

Secondary data was collected from reviewing relevant literature from text books, private studies done by other scholars (printed and unprinted publications), research projects, journals Government of Kenya publications and e-pages on wetlands, their reserves and demographic publications. These provided the general background information on management theories that have been advocated in the past, legal framework, and other relevant information on urban area dynamics.

1.5.3 Sampling Design

The study used purposive sampling method with the researcher targeting the members in the neighbourhood who had a direct contact with the dam. Opinion leaders were targeted as they knew the facts on the ground and were actually involved in running the activities taking in and about the dam. With three settlement sides to the dam, questionnaires were administered on the basis that respondents were evenly spread out on the peripheries of the dam

1.6 Data Analysis and Presentation

The data collected was analyzed and presented in:

- Qualitative description and interpretations in written text
- Simple tables and chart presentation in reporting the quantitive data collected.
- Digital (plate/pictorial) images.

1.7 Study Assumptions

The researcher assumed that all respondents were rational, had no influence from other informants or respondents and were willingly supplying truthful information

1.8 Justification for the Study

This study is essential, as it gives documentation on the areas of management of wetlands that are linked to urban wetlands and wetlands of national importance. In the field of water provision, Kenya has been ratified as a water scarce country and hence management of water bodies is a major issue if water provision and sanitation of all people is going to be achieved. It gives much importance to management aspects that are easily identifiable and gives an evaluation of what has been currently been the methodologies employed in managing of wetland in its findings. Wetland managers can use it as a base for identifying new and more strategies to implement their management activities of wetlands. It can also provide areas for formulating updated management policies and laws that can empower urban area wetland planning and control. The management of wetlands deserves to be looked at as it gives practices that can be used. Local authorities and other stakeholders involved cannot manage wetlands sustainably if they are unaware of the current practices in use and the socially acceptable newer methods that will have stakeholder support.

The study is worth pursuing because the present and future Kenyan's need water, a well preserved environment and a working eco-biological natural phenomena for all their daily livelihood and basic survival. The welfare of high density areas like informal settlements (e.g. Kibera) is largely dependent on the availability of affordable easily accessible potable water.

With the collection of relevant and updated factors of management of wetlands, data is added to the stock of knowledge, which can be used by other academic scholars as a basis for further research.

1.9 Organization of the study

The study is organized into five chapters. Chapter one being the introductory gives the topic of study. Chapter two discusses the available literature on the topic developing a theoretical framework upon which the study is based. Chapter three gives the study area giving a brief history of the area. Chapter four entails a presentation of the data collected and an analysis of the data while chapter five gives a summary of the main findings from which the conclusions and recommendations are made and points out areas of further study.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

The terms wetland and management are two fields that have an interplay where wetland is the subject and management is the discipline. It then follows that the two areas are related by a single bond that is to search a way out for issues facing wetlands. Expert opinion is management. But what are the areas to be managed, whose interests are at stake, are there any manageable elements of wetlands, are it a worthy cause? These are questions often heard and raised. For wetlands, their role in urban areas has been clearly defined in draft bills, planning schedules and other legal documents that are formulated for their presence and perpetual existence.

2.1 Wetland

The term wetland is a composite noun that is formed from two words; 'wet' and 'land'. According to Encarta dictionary wet means something that is damp, moist, soggy, soaking, sodden, watery or drenched in water or a liquid. Land on the other hand is the physical solum, from the centre of the earth up to the sky. As one thing, a wetland can thus be perceived as the physical solum drenched, soaked in water or damp, moist or soggy with water. They are areas where water controls the environment and the associated plant and animal life.

According to Environmental Management Authority, National Wetland inventory U.S, wetlands means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support a prevalence of vegetation typically adapted for life in saturated soil conditions to include swamps, marshes, bogs and similar areas of a transitional nature between terrestrial and aquatic systems where;

- At least periodically, the land supports predominantly hydrophytes
- The substrate is predominantly undrained hydric soil and
- The substrate is non-soil and is saturated with water or covered shallow water at some time during the growing season of each year (Environmental Management Authority, National Wetland inventory U.S).

Riparian reserves are lands along the margins of streams, unstable, potentially unstable areas where special standards and guidelines direct land use, those portions of water shed required for maintaining hydrologic, geomorphic, and ecologic processes that directly affect standing and flowing water bodies such as lakes , ponds, wetlands, streams, stream processes, and fish habitats (Northwest Forest plan U.S)

According to Ramsar convention on wetlands held in Iran in 1972, wetlands are areas of marsh, fen, peat land or water whether natural or artificial, permanent or temporary, with water that is static, or flowing, fresh or salt or brackish, including areas of marine waters, the depth of which at low tide does not exceed six meters (Bhaskar Nath, 1990; Mitsch and Gosselink, 1993). This is the universal wetland definition that is adopted by international organisations but each local situation allows for variation of this definition to suit the requirements of an individual institution or group involved with wetland issues. In the words of Environmental Management and Coordination Act of 1999, an act of parliament governing Kenya's environmental issues, a wetland is stipulated as an area permanently or seasonally flooded by water where plants and animals have become adapted.

Wetlands include the following areas:

Table I. Types of wetlands

Shallow lakes	Springs	Mountain bogs
Edges of deep lakes	Seasonal pools	Mangroves
Rivers	Seeps	Open coastlines
Manmade reservoirs	Seasonally flooded grasslands	Coastal beaches
Wells	Flood plains	Rice paddies
Swamps	Deltas	Marshes
Estuarine areas		

(Source: E.M.C.A, 2000)

Although wetlands are providers of many products and services, and there are reciprocal impacts between humans and wetlands, wetlands management has often been uncoordinated, with only a few commercial objectives being emphasized. Fringe wetlands near lakes and rivers are among the least investigated aspects of these ecosystems. Wetlands are among the most productive ecosystems on the planet, covering approximately 5.6 million km2 of the earth's surface. They support a wealth of biodiversity, and provide a variety of ecosystem services essential to human existence (Ramsar Bureau, 1991). Urban wetlands can provide multiple values for suburban and city dwellers (Kusler *et al.* 1988). The aesthetic and recreational amenities of urban wetlands, and their value as a wildlife habitat, can be significant. The presence of a functional urban wetland gives flood control and this can also be very important for storm water drainage.

These wetland ecosystems are socio-economically important for:

- Drinking water abstraction.
- Irrigation purposes.
- Hydro-power generation.
- Fishing.
- Recreation, and sporting activities.
- Transport.
- *Agriculture,_ silviculture, horticulture or aquaculture(food production)*
- Animal husbandry.
- Industrial growth.
- Building materials provision
- Aesthetic, archaeological, educational and gene pool benefits that are non consumptive non quantifiable benefits.
- Animal dispersal corridors.
- Medicinal importance.

Ecologically, wetlands are instrumental in water storage, filtration and supply, flood control, perform sediment, nutrient and toxins retention functions and are also important habitats for bio-diversity both flora and fauna. Wetlands support high concentrations of birds, mammals, reptiles, amphibians, fish and invertebrate species. Wetlands are also important storehouses of plant genetic material that is desirable for research in food production and security. Rice, for example, which is a common wetland plant, is the staple diet of more than half of humanity (Takashi, 1999) but contemporarily wetlands are the most important "cradles" of biodiversity, because of the vicinity of water and land, where thousands of rare species can live and develop. In addition, wetlands have the function of being the "kidneys" of a land, cleaning and regulating ground and surface waters. They are therefore among the most densely populated sites in the region (Bootsma and Hecky, 1993). In order to understand the changes in wetlands, we need first to understand the human demographic changes and patterns and their land-use activities in the catchment areas.

2.2 Types /categories of wetlands

Under this research, to ensure consistency, the categories below have been selected to suit purposes of discussion as a wetland has many forms of classification, namely;

- Natural - undisturbed wetlands
    - -disturbed wetlands
- Exempt wetlands
- Restored wetlands
- Created/ Man-made - degraded wetlands
    - –un degraded wetlands

Throughout the discussion, references to **natural wetlands** are assumed to apply as well to **man-made wetlands** created under regulatory requirements and where the Nairobi dam falls under. Natural wetlands do not exist as a result of man's activities. They include rivers and lakes.

Created or manmade wetlands are built mostly for water quality improvement purposes. This typically involves controlled outflow and a design that maximizes certain treatment functions, where it involves bringing a wetland into existence, whether by accident or intentional, where none existed previously; but this includes creation of wetlands for mitigation, habitat, and water purposes (Fields, 1993).

Exempt wetlands are those wetlands that are not under statutory regulation and tend to mainly be created in privately owned land, hence roughly fall into the created wetlands category.

2.3 Management

The management fundamental theory and principles have universal application in every kind of an enterprise (Koontz and O'Donnell, 1990). The management process is a necessary feature of all organized activity. It is a social process entailing responsibility for the effective and economical planning and regulation of the operations of an enterprise in fulfillment of a given task, where the responsibility includes

- ∝ Judgement and decision making, devising and determining plans and using data to monitor performance against plans.
- ∝ Guidance, integration, motivation and supervision of staff comprising the enterprise and carrying out its operations (Brech,1975: 19)

From these statements, it can be seen that management is

- A process
- A function
- Transferable in elements

Wetland management generally involves activities that can be conducted with, in, and around wetlands, both natural and man-made, to protect, restore, manipulate, or provide for their functions and values. This discussion of wetland management is divided into issues associated with:

- Natural wetland protection;
- Activities, involving natural wetlands that are specifically exempted from regulatory requirements;

- Wetland creation and restoration;
- Wetland reconstruction for water quality improvement.

Management is on how guidelines can be mapped best to conserve and utilize wetland resources. The management goal for wetlands is typically to perpetuate the existing functions. Functions are specific to a wetland's type and its position in the landscape. Management generally involves activities that can be conducted with, in, and around wetlands, both natural and man-made, to protect, restore, manipulate, or provide for their functions and values.

2.3.1 Management as a Process

Management is a wide array of interlinked activities that are positively oriented towards achieving a clearly defined goal or sets of goals.

It is a structure based flow of thought and activity that involves;

- Information acquisition or generation,
- Communication,
- Resource planning,
- Collaboration cum participation,
- Empowerment,

Management is a systematic procedure that is a basic requirement for any function and is guided by the following tools

- Planning
- Environmental assessment
- Participatory approaches
- Institutional coordination
- Capacity building

According to agenda 21 principles, development is hinged on environmental protection as a large percentage of resources of economic process are on land, or connected in one way or another.

Management of wetlands is a serious discipline in itself but comparatively a rather new phenomenon. This means that there is not only a huge demand for competency (proper, quality and high calibre training) in this area but also serious inadequacy (very few

trained experts). This is a big challenge for sustainable conservation, management and wise use of wetlands.

2.3.2 Management as a function

Wetlands and riparian reserves are a subject of purpose driven management that is done by institutions charged with a certain responsibility.

It is in this understanding that management is carried out through

- Organization- where the work/activities are allocated to individuals or groups of individuals, and allocated responsibilities and resources.
- Project life cycle planning _where all events to be carried out during the management of wetlands are ratified and scheduled over time to show what comes in the beginning, middle and end of the project(s) undertaken.
- Risk analysis_ in project implementation areas that may generate harm, disagreements, economic losses exposure and physical damages that may arise directly or indirectly from management activities.
- Efficiency and effectiveness measurement _ where the activities of management are evaluated in real terms by standards set before, during or in the evaluation stages of a project.
- Budgeting _ is a very essential step in any management activity that is supposed to spend resources that are scarce and are allocated to various activities, phases of activities or stages of a project.
- Policy analysis_ is a scrutiny of the existing objective statements of intent that are laid out to guide the pursuit of performance; in this case, of management.

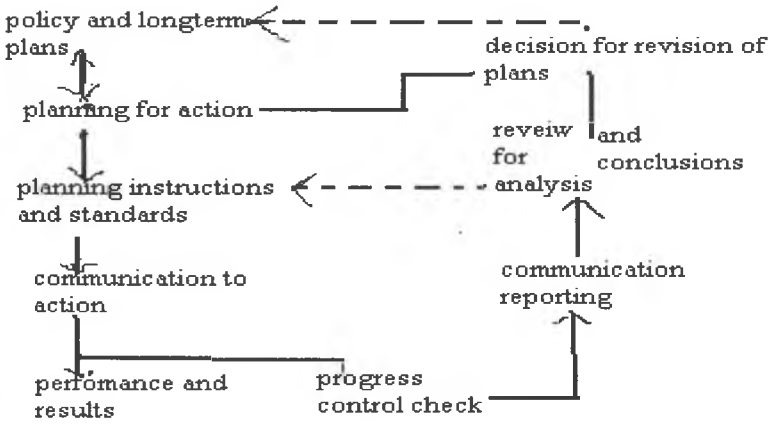
Two major facets of managing wetlands for protection include buffering wetlands from direct human pressures, and maintaining natural processes in surrounding lands that affect wetlands and that may be disrupted by human activities.

2.3.3 Transferability of management elements

In management elements like pollution that are spread by autonomous agents are transferred from point to another, making management to acquire a wide scope.

Exogenous variables are hence a factor that takes a new defined scope in environmental resources (Earthscan, 2003) between their harnessing and damaging them.

Figure I: Management decision process



(Source: Brech 1975:33)

The lines show and embody human actions (consultation, communication, motivation) where management judgment is exercised at all stages appropriately with the solid lines showing normal expected flow, while the broken lines indicate periodic or possible flow.

2.3.4 Management objectives

Wetland management is a process through which people can develop a vision, agree on shared values and behaviours make informed decisions and act together to manage the natural resources of a river basin. These are the purposes set out to be achieved by managing a resource. According to Harold Koontz, in his book 'Towards a unified theory of management, he gives management objectives a formation basis of being S.M.A.R.T i.e. Specific, Measurable, Achievable, Result oriented, and Time constrained or conscious.

The objectives of wetland management are:

- ∝ Sustainable use of wetland
- ∝ Ensure positive results on conservation,
- ∝ Stakeholder involvement
- ∝ Local community participation
- ∝ Natural resource enjoyment.

2.3.5 Principles of wetland management

There are principles set out by the Ramsar convention to guide activities aimed at going round wetland issues on a systematic, well organized way. They include:

- Wise use of wetland principle

This is a principle that promotes sustainable utilization of wetland resources for the benefit of humankind in compatibility with the maintenance of the natural properties of the ecosystem.

- Principle of interdependence.

Wetland issues cannot be isolated from other social political and institutional issues hence must be looked at from a multi-sectoral dimension across any socio-economical barriers.

- Precautionary principle

All potentially harmful activities that might have a direct or indirect negative impact on wetland should not be carried out even if they have not been scientifically proven.

- No net loss principle/compensation principle

It is established that if an institution, developer or individual causes harm to a wetland ecosystem, he /she must restore the wetland to a point it was before.

Using these principles, management addresses itself to

- Social issues –Population growth and demographic trends, lack of awareness, land ownership and employment.
- Economic issues –Divergence of private and public benefits accruing from wetlands.
- Legal issues –protection of wetland areas legally, coupled with enforcement of legal aspects of conservation.
- Policy issues –Preparation of specific wetland policy away from water resources policy to overcome disregard of wetland ecosystem and their specific requirements.
- Institutional issues –Adequate resource allocation to provide for wetland institutions, coordination ~~of~~ sectoral institutions and development of joint management methodologies.

2.4 Management Perspectives

An urban understanding of management options is a basic focal point for the formation of the existing problems that face fragile ecosystems. In Kenya, water and wetlands resources are estimated at 15 million kilometers square (Kenya land reform, Vol. III). Management has to find options for effectively dealing with this vast area that is under the wetlands.

These options are both locally created and implemented to suit the local situation adaptable to the conditions pre-existing the management of a wetland ecosystem.

A deeper understanding of management functionality and resource sustainability are two concepts that are intertwined to reflect the cause and consequence relationship of the two. Expansion of urban areas in the wake of a population boom and urban sprawl issues is a cause of alarm that is a threat to wetland areas that are cited as suitable urban agriculture areas (Olima, 2002). This subtle settlement strategy is a manager's problem to tackle in the use of a zone set out for the purpose of the wetland.

Management of a wetland is open to many options but the following stand out as they give an agreeable form of socially acceptable mode for thematic articulation of management.

2.4.1 Regulations

Management is about what has been formulated to be done, carried out or implemented. Regulations run through the implementation framework that underscores the importance of a strict way of doing things as they act as a forbidding, restricting or controlling mode of operation in dealing with issues of managing wetlands.

They spell out the "do's and "don'ts" of a project. They are used as an integral part of guiding action to avoid errors which can result in environmentally harmful effects of undertaking a project.

The regulatory framework is a part of institutional framework that stems from the central government and is supported by the local government. The management entity may be a department of government e.g. the department of water resources, or Kenya wildlife services, a local government agency, a regional planning organization, a conservation group or other natural resource management organization, or other public entity that has

adequate powers and resources to carry out the responsibilities authorized in a comprehensive manner.

The management goal for all wetlands is generally constrained by regulatory government policies and program requirements to the protection of existing functions or restoration of degraded functions, (Kenya land alliance Vol. 3, 2002, 64). Implementation of regulations in management is a major factor in the success or failure of a project as they form the legal backing that protects the welfare of the public.

2.4.2 Standards

Standards are elements of what is pre-established, hand picked to form the benchmark of the proposed management work. They are a set of rules that give a level of minimum achievement for a set of activities to be carried out.

Standards in wetland management perform an important role as they give a level to which a well preserved wetland is evaluated. Any form of standardization will result to cost effectiveness of management practices.

Costs involved include some of the following :

~**Research and development costs** - These are those expenditures that the management group incurs in generating and testing a pilot project, a prototype of a new management practice and developing a management system ready for implementation. They involve collection of data necessary for the broad structuring of the projects to be undertaken, a pre-evaluation analysis of the acceptability, implementability and overall success of management.

~ **Administrative costs** – These are the costs incurred by the pursuit of legally enforceable conditions of managing the wetland, as envisioned in the objective statements and core personnel functions.

~**Investment costs** –Are costs incurred in purchase of prime capital equipment special equipment, construction, management personnel training and acquisition of initial spare parts. These costs set the management moving as it engages itself in its operational activities.

~**Operative costs** –Are expenses incurred in the phases of wetland management projects.

~ **Winding up costs** – Are costs that are involved with phasing out a project or closing down a program.

All these are costs that are well delineated by following a set of pre-established standards that give a general assessment of all costs that can be incurred, maximum, or minimum. For international wetlands, the application of the I.S.O 14000 series forms the standards under which the environment is managed. The use of Environmental management and audit system (E.M.A.S) in the European Community replaces the I.S.O series.

In Kenya the use of the environmental impact assessment (E.I.A) forms basic standards for which a project has to adhere to when carrying out its operations.

2.4.3 Licensing

This is a way of allowing certain restrictive activities which can ignore the economic needs of communities living around the wetland as they are the "custodians" of the resource. Exploitation of natural resources should envisage the uplifting of the communities living adjacent to the resource (Syagga, 2006, 52).

A balance has to be struck between the environmental functioning of wetlands and their use for livelihood purposes. It is a concept that is explored under the premise that certain things like sport fishing has to have a limit and a control to eliminate cases of excessive removal of certain fish species. On another level, licensing of activities that may in a way, either known or unspecified affect negatively wetlands can be done. It includes permits on pollution that a firm or company can dissipate into the environment.

In this case a license application may need to include a plan depicting the proposed activity as well as engineering and/or environmental information describing its impacts. Licensing is normally done by the managing authority and revenue used for promoting the area being licensed.

2.4.4 Education

Management of any item, area or facility is based on the knowledge acquired and its relevancy to that specific activity. In using education, management team will create the necessary skills for the practices to be carried out on wetlands.

Management is centered on availability of expertise on nature's complex processes and schools offer a good skill imparting ground, where tertiary institutions carry out researches into ecology of wetlands, technical schools form the machinery for mechanization of management. Wetland management requires knowledge on a range of wetland subjects. Education component provides current wetland information and leads to other materials that can assist wetland and watershed managers. This information can help a decision-maker evaluate wetland resources in a watershed to determine their functions, values, and roles in the watershed, assess risks, and prioritize protection where the level provided should conform with the designated use established for a wetland for example, aquatic life support or recreation purposes. Education is a tool used by government agencies to give a base for wetland information to the general public through learning curriculums on environmental issues. Schools may also value the opportunity for hands-on environmental education and involvement.

2.5 Waste management

According to Syagga (1992) urban environment management should be highly focused on waste management as environmental issues are interlinked to substances that are foreign to the feature of the environment that include soil, water and air.

Wetlands are subject to human pressures and this puts a colossal task on the management team to seek ways of keeping the disposal of urban waste onto fragile ecosystems like the one discussed herein of wetlands.

Waste management is a critical issue and has been widely studied, researched and reports presented on the findings, materials have been published and this necessitates mentioning waste issues in dealing with wetland management as it is a large contributor to their degradation.

2.5.1 The Relationship of Wetlands to Water Pollution

Wetlands play a role in reducing pollutant levels of inflowing water, but the use of natural wetlands for water quality treatment for either point or nonpoint pollution sources is inappropriate (Fields, 1993). Wetlands are subject to changing water regimes and many water points are open. This exposes the water to point pollution (where pollutants are dumped into the water or wetland area directly) or non-point pollution (where the

pollutants are dumped further afield and water carries the polluting substances in physical or dissolved states) but wetlands have in the past treated and continue to treat both point and nonpoint discharges. Pollution takes the centre stage in wetland issues as urban areas are known to generate massive amounts of wastes with much of it going open dumping disposal methods in LDC's, where wetlands receive largely untreated runoff from much of the developed urban and agricultural area of the country (Fields 1993).

Standards e.g. using water quality standards dictates those wetlands be protected from such input of substance which is a form of proper management. Pollution renders water unhealthy for human and livestock use, ruins aquatic life and restricts recreation facilities. Water sporting and sailing may be interfered with, especially where eutrophication changes the wetland ecology, encouraging massive growth of aquatic vegetation

Pollution in most cases is thus a subject which management of wetlands takes very seriously as it is a major constraint to sustainable use.

2.5.2 Pollution control management

The debate on pollution and its control takes a multi-disciplinary context where factors to be studied include:

- ∝ Agricultural mineral nutrient, e.g. Phosphorus (P), Nitrates (NO_3, and NO_2)
- ∝ Physical organic matter, e.g. Sludge
- ∝ Metals e.g. Lead,(Pb), Manganese, (Mn)
- ∝ Biological pathogen e.g. Algal blooms
- ∝ Loadings from storm water runoff and
- ∝ Wastewater / greywater discharges

While physical waste is slightly easy to control, chemical wastes take a complex processes with large capital outlays, requiring wide and variate technical expertise, while this might not be locally available in Kenya.

2.5.3 Appropriate research and use of technology

Technology is changing each day and this puts the management of environmentally susceptible areas in an advantage to apply new techniques of management, innovative mechanical advancements ease to drudgery involved in dealing with hard tasks.

Research produces newer ways of procuring biological plant species, water engineering introduces new ways of cleaning damaged ecosystems while information technology allows for sharing of information across the globe on management issues arising, computerized collection, manipulation evaluation and storage of data.
This data is essential for planning purposes, forecasting and evaluating the works done over long periods of time.

2.5.4 Land use control

Wetlands are not just the visible damp or soggy areas. They constitute more in their catchment area, from where wetland management involves maintaining important natural processes that operate on wetlands from the outside and that may be altered by human activities on private lands, agricultural farms and industrial processes.
Land parcels abutting wetland habitats are of a major concern as they directly interlinked to the support and operation of wetlands. Management of wetlands will be focused on controlling the uses to which these land parcels are put to avoid contamination of water, addition of material substances like refuse as well as encroaching on the area set apart for the wetland.

2.5.5 Awareness creation and sensitization

To solicit public commitment to effecting community participation in wetland affairs the management group is entrusted with the task of carrying out public education to sensitize people on what are the issues facing them if management of land resources like wetlands are not conserved and to show the various benefits that can accrue from a sustainable management practice.
Publicizing the value of having wetlands will illustrate to all people the different values of conservation. **Values of wetlands** can be: **Direct use value (D.U.V)** - is the value of the amenities derived from the wetland ecosystem. They include fish for local consumption, reds for thatch, water for drinking, tourism (both local and international) e.g. Bamburi nature trail, hunting and wildlife conservation.

Option value (O.V) – is the value that an ecosystem gains by having people want to retain it in its natural condition without further use e.g. extraction of drinking water.

Existing value (E.V) – is that intrinsic value that arises from having a well preserved ecosystem that people want to have though they never visit but are contented with the fact that it is visited by others. It applies mostly with policy makers of wetland issues who may be far away but know the local people visit the wetland.

∴ **Total value (T.V) = D.U.V + O.V + E.V** (Cobham,1990)

To create awareness, realistic efforts are put in use through engaging the local community in public meetings (baraza's), use of printouts like pamphlets, brochures and outdoor advertising on bill boards to ensure the message is spread, distributed and dispersed far and wide.

Production of periodic bulletins and regular magazines that are circulated locally, television documentaries and programmes, field days, public open days and radio advertisements, use of the internet based open websites and e-pages are also ways open to include the media in productive promotion of the activities being carried out on wetlands that enhances public awareness.

2.5.6 Demand management

Wetlands encompass both land and water. These are two natural resources that are open to scarcity especially where Kenya has only 20% of total land mass as habitable (Konyimbih, 1996). This makes wetlands susceptible to agriculture and other uses that are in negation of their presence and/or existence.

Takashi *et al* (1999) elaborates on the aspects of cities that sometimes spread and deplete nearby areas of water. It is then in the interest of wetland preservation and sustainable use to control the demand placed on the wetland areas by the rapidly expanding urban areas, being in cities, towns or any urban area.

2.5.7 Eco-development

This is a term formed out of two terms- ecology/ecological and development.

It gives a standard mode of carrying out development around the wetland, its vicinity, the riparian zone, buffer and catchment area in a way that there is no ecological disturbance of the wetland. The Occasional paper no.15 of 1975 done by the Institute of Development Studies (U.O.N) looks at progressive development around fragile ecosystems as one of

the major contributing factors to their degradation. Wetlands are a part of social capital. Thus the development of a management scheme, its implementation, operation, monitoring and evaluation leads to a betterment of the capital base. The presence of resources necessary for the operation of an urban region as an economic force in wetlands gives a socio-dynamic force to the presence of developments and which are a natural cause of disturbance of wetland ecology.

2.6 Management Strategy

The presence of natural resources of land, water and air within wetlands gives a new delineation as to the way people respond to these vital resources in a market controlled economy. Wetlands have a tendency to be viewed as 'waste' lands hence their real value is less than that of the market. The best farm lands have been salvaged from flood plains and valley bottoms. The best fishing grounds have been in estuaries fed by tidal marsh and this gives the unique way in which man's history and wetlands has changed perception and management of wetlands (Telford, 1994). This mode of relying on wetland for sustenance has changed to industrial revolution's utilitarian view where nature is exploited for economic development (Telford, 1994) and this necessitates the formation of a strategy that highlights issues to be dealt with in the management of wetlands. A strategy hence gives a plausible way of understanding and going around wetland management issues with the necessary diligence and professionalism, withholding all the challenges and appreciating ways currently possible within budgetary provisions of a management plan.

The following factors are considered in setting the designated use and developing a management strategy for a wetland:

- Wetland type and landscape position,
- Surrounding land uses,
- Cumulative impacts on the wetland,
- Vegetation presence and quality,
- Presence or absence of rare or endangered species,
- Surface water quality,

- Wildlife habitat, and
- Cultural values.

The management strategy adopted will involve several approaches depending on the wetland and its inherent characteristics whereby the management is simplified into three elementary levels:

- Community based wetland management
- Watershed management and
- Ecosystem management

2.6.1 Wetland type and landscape position

The aesthetic and recreational amenities of natural or created wetlands in an urban setting, and their value as a water resource, wildlife habitat or other appropriated use can be significant. The capacity of a functional urban wetland in flood control can also be very important. Managing it hence gives the challenge of protecting a wetland's existing functions in an incredibly complex modern landscape.

The wetland type gives management team a window through which it can frame its scope of activities as per the existing conditions of the wetland itself. A degraded wetland calls for differing management scheme from non-degraded wetland.

Management of wetlands in rural areas will also differ from that of urban and peri-urban areas where issues of human intervention differ.

Wetlands are located in social systems, physical, economic and institutional environments where differing perspectives appear and where management plays an inter-disciplinary role, from environmental law to resource management to capital management (Telford, 1994).

2.6.2 Surrounding land uses

Wetlands are located amongst other land uses on the physical stratum that is the earth. To correctly identify and deal with exogenous variables affecting or involved with their functioning, land uses surrounding the wetlands have to be well known (Thompson and Mitlin, 1995; Davis, 1993). The ability of wetlands to provide specific functions is linked

to characteristics and processes of the surrounding landscape, and therefore effective wetland stewardship and management must operate within a landscape context. Wetland management must consider causes and consequences beyond the wetland boundary.

Wetlands can be seen as distinct natural systems but are affected by and have effects on other systems. Management must go beyond the 'wet' land to encompass the greater system of which the wetland is a part. For wetlands located near or within urban areas, management may not necessarily mean reservation of the whole catchment, but particular care of sensitive areas that make up the wetland base. These areas will include the wetland buffer zones and riparian reserves.

2.6.3 Cumulative impacts on the wetland

All activities whether natural or human have been found to have an effect on wetlands. Activities of man tend to aggregate into one in the long term, and this gives wetland management a history to deal with, where things that happened in the past show up today in a large way due to periodic human activities like the use of agro-chemicals and hazardous compounds in controlling nature. This is shown by the long researched chemical D.D.T that is held up in the ecosystem for long periods without biological remedy for breakdown hence its cumulative damage to the environment.
Mitsch (1993) cautioned that the downstream wetlands could retain more mass of nutrients than an upstream system, which shows that various activities done upstream will total up to a larger effect for a wetland like a dam, made out of river based water source. Management will ensure there is less chemical runoff to pollute local water resources.

2.6.4 Vegetation presence and quality

Wetlands can be forested, where riparian areas form the bulk of vegetation. Mangrove forests are a good example of vegetation that occurs in wetlands. Flood plains have grasslands and the periodic water regime alters the presence and type of vegetation.
The effective management of wetlands will seek to establish the various species present in the wetland, whether indigenous, exotic, invasive or dormant plant stock and their

quantities and life cycles. For water bodies, the presence of plant life that may include floating, submerged, partially floating and partially sub aquatic plant species.

2.6.5 Presence or absence of rare or endangered species

The wide spectrum of animals in the wetland realm gives uniqueness to wetlands through nature conservancy that attracts majority of protection measures.

The absence of these rare species may also necessitate real time conversion of the wetland to focus on one use e.g. water abstraction or water treatment that are a way of disturbance that if well implemented is beneficial for drinking water, or other wetland uses that are in line in conservation or restoration of wetlands.

The endangered species can be both flora and/or fauna which are specified in the management manual to be inclusive of protection measures

2.6.6 Surface water quality

Wise use of wetlands cannot be separated from wise use of the water that sustains them. Wetland restoration can be an important contributor to downstream habitat and water quality recovery in urbanized landscapes (Kusler, 1994). For wetlands to be sustainable, management decisions regarding wetlands, and the use, reuse, and disposal of their water, must be made at the basin scale or higher. Wise use of these water resources must be the guiding principle. Such decisions are often trans-boundary in scale and complex in character. Nairobi's rivers suffer from contaminations by agriculture, slums and industrial areas (Wandiga, 1996) thus wise management schemes require educated stakeholders who have broad interdisciplinary backgrounds in science, management, and policy regarding environmental issues touching on the water and linked resource base.

This will enable them to make informed assessments within a dynamic ecological and socioeconomic landscape. Wise use not only demands complex knowledge, but also requires ethical grounding to address both human and ecological concerns that are aimed at clean water standards through water and bio-systems engineering.

2.6.7 Wildlife habitat

Wetlands have the tendency to play a key role in animal dispersal tendencies where the water is essential for drinking by animals while, the forest and vegetation base offers habitation for living.

2.6.8 Cultural values

Wetlands are a major determinant of human settlement as historically people settle near water resource as they provided fishing, agriculture, and other sustenance opportunities that apart from drinking water, accrue to the people.

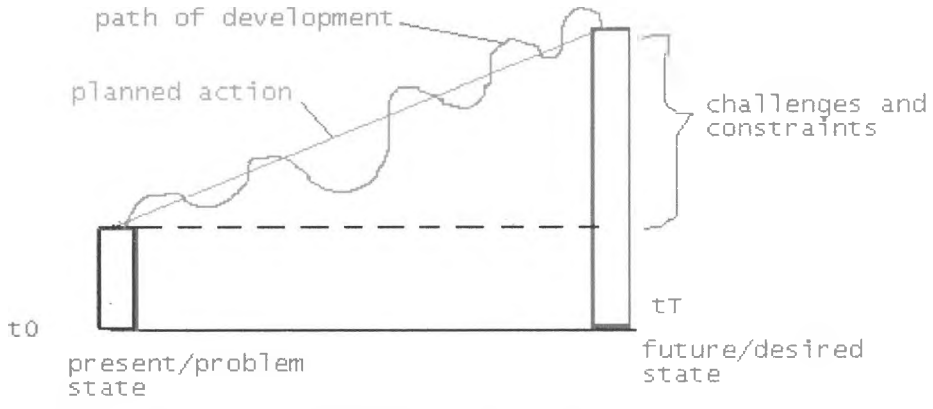
It is in the realistic appreciation of the value of the relationships between people and hydrological cycle of water that culture has evolved to regard wetlands as areas important for human livelihood.

2.7 Planning of management

Planning is establishing what is to be done while smoothening the way to make it happen that involves forward thinking in time (Burke, 2003). Planning is a discipline that provides the right site at the right time in the right place and the right people (Ratcliffe, 1981). In this view, planning is seen to be a basic human activity that is engaged knowingly or unknowingly at all levels from the individual to the community, to organizations to the whole nation.

Keeble (1981) sees planning as the art and science of ordering the use of land and the character and the siting of buildings and communication lines and routes so as to secure maximum practicable degree of economy, beauty and convenience.

Figure II: The planning model



PLANNING PROCESS MODEL FROM TIME 0 TO TIME T WITH REFERENCE TO CHALLENGES AND CONSTRAINTS.

In Kenya, planning for wetland issues is contained in the National Environmental Action plan (N.E.A.P). This is a plan that gives an analysis of natural resources in Kenya together with an analytical profile of *uses* and *values* of these resources. It gives the appropriate legal and fiscal incentives for the business community to include environmental considerations in their operations.

It also stipulates the available methods of awareness of environmental issues, giving recommendations on policy and legislative approaches to combat negative environmental concerns. This plan is concerned with the general natural resource and wetlands have unique features that require specific intervention measures other than a generalization within other resources. According to Dewey, 1990, he asks three questions to allow for the formation of a sound plan.

- What is the problem,
- What are the alternatives, and
- Which is the best alternative

For Kenya, wetland management issues can be analyzed through Dewey's three question step mode. Asking what are the issues facing wetlands, the various constraints prompting management, and evaluating all the solutions as alternatives of management as well as researching to find the best solution that gives a balance of all forces involved in financing, regulating, evaluating and running wetland.

2.7.1 Objectives of planning

2.7.1.1 Restoration, Preservation and Protection of wetland resources

Planning for wetlands will seek to find applicable ways to restore retain or re-establish wetlands. This is significant for the protection or enhancement of aesthetic, scenic, recreational, tourism values, manage habitats important for native flora and fauna, migratory bird species, access ways important for fish. This goes hand in hand with promoting the concept of managing all wetland catchments so that the complex relationships that exist within a wetland, and between a wetland and surrounding ecosystems, are taken into account. Restoration is the process of returning the wetland system to an approximation of its pre-disturbed condition. Restoration is sometimes difficult and the major challenge of restoration is the replacement of the structural and functional aspects of a naturally formed wetland. Restored urban wetlands can help protect floodplains and streambeds that are otherwise degraded by urbanization forces, and can help to minimize downstream flooding that can result from urbanization. Thus the intensity of restoration techniques will depend on the level of disturbance to the values of the original wetland.

Restoration may be required as part of a permitting process, but restoration efforts may also be prompted by environmental resource management goals for habitat or water quality improvement in keeping with the net- recovery clause of the no-net-loss goal.

2.7.1.2 Wetlands Inventory

Planning will put forth ways of collecting information on all aspects of a wetland, running from the components of the wetland, the number of fauna and/or flora species in the wetland and to connect the national inventory for wetlands with other related government resource inventories to ensure optimal compatibility of the inventory from financing to policy considerations. The management of wetlands will utilize an interdisciplinary approach, drawing upon scholarly literature to address the biological, physical, social, economic, and political drivers of change in wetland management which have to be recorded for evaluation purposes. Inventorying all these stakeholder interests takes a varied scope ranging from acceptable activities, to out rightly statutorily forbidden activities.

2.7.1.3 Public Awareness on environmental objectives

Planning is a human activity that aims at coming up with a better quality of life for the target communities, individuals or groups. It seeks to make work, living, and leisure environments safe, healthy, efficient and convenient with the use of available resources through effective service delivery systems and ensuring that people's habitat is aesthetically appealing. Planning should therefore promote the environmental objectives of convenience, comfort, pleasantness as well as elimination of annoyance e.g. offensive odours, and unsightly waste pollution substances.

This will promote the tourism and recreational potential of wetlands, preserve and enhance the opportunities afforded by wetlands for education, scientific study and recreation as well as encouraging public participation in the planning and management of wetlands.

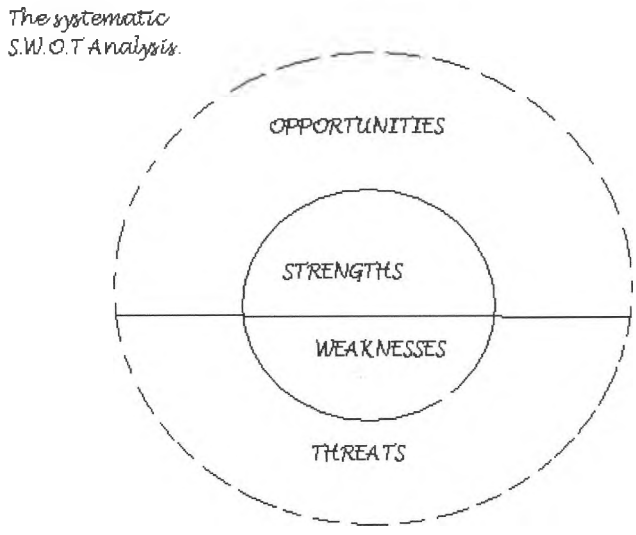
2.7.1.4 Basic principles of planning

Planning deals with the proper use of land and natural resources and mainly focuses on people and their activities. It anticipates the future and puts measures to increase programs that aid or aim at improving human settlements and ecosystem habitats.
The guiding principles include

- A clear and well thought out decision making process.
- Comprehensive stakeholder involvement where all the affected parties are given the opportunity to engage in constructive dialogue and get informed on proposed wetland activities e.g. draining, reclamation, restoration and fencing off.
- Accurate information concerning the current issues facing wetlands, information on proposed activities and all other parameters involved in wetland management.
- A range of viable options and alternatives to choose from is also vital in guiding any planning action.

Using these four guiding principles, management will form a plan to fit the various wetland activities. It will take a comprehensive S.W.O.T analysis then to establish a proper way forward.

Figure III: The S.W.O.T analysis



The opportunities for wetland management could be the expansion of technology, more skilled populace and lobby groups, strengths could be natural resources that are naturally there hence no creation costs, and social good will, weaknesses could be lack of focus, low initiative as well as lack of information and technology.

Threats could be political ill will and instability, un-enabling policies and strategies that are further promulgated by confusing ideologies and prohibitive cultures and social norms.

In this view planning, both in the urban and regional sense will provide specific interventions as well as solutions for development in environmentally sensitive areas, the role of all areas within the region e.g. agriculture and designate essential public utility areas giving due considerations to zoning laws, regulations, policies and environmental standards.

CHAPTER THREE

CASE STUDY AND DATA COLLECTION

3.0 Introduction

The study area whose management was under study was the Nairobi dam.

3.1 Back ground to the study area.

Nairobi dam was established as a water reservoir to provide clean adequate water to inhabitants of Nairobi. It was commissioned in 1953 as a reservoir for water supply for the City of Nairobi during the colonial period before the independence of Kenya in 1963. During the initial years the dam also acted as a recreational facility with such activities such as sport fishing, picnics and other related uses like abstraction of drinking water taking place.

3.2 Location and size of the dam

The Nairobi dam is located to the east of Kibera informal settlement, next to the Laini Saba village. It borders the Nyayo High Rise Estate to the north and touches various privately owned properties to the west and south towards Langata. Among these properties is the Nairobi Sailing Club.

Accessibility to the dam is via a stone rammed, partially tarmac access road from Langata road (C 58) from the NCBD, or through the Nyayo high-rise estate which is currently fenced off due to security of residents. The other access route is through Kibera to the dam directly below Undugu society grounds and school.

The Nairobi Dam is shallow with a documented surface area of about 356,179 m2 and a volume of 98,422 m3. The average depth of the dam is 2.76m on the shallow end and 16.5m on the deeper end. The dam inlet is about 1700m while the dam crest is about 1680m above mean sea level. The dam has a mean area of 36 acres but this currently is subject to revision due to reduction of water due to agriculture, heavy solid waste influx and sedimentation.

3.3 Nairobi dam profile

Motoine River is the Dam's main tributary and it flows into the artificial lake meant to provide drinkable water for residents of Nairobi and further onwards, the stream

continues as Ngong River. The Nairobi dam acts as a manmade reservoir within Nairobi in the Athi catchment area.

3.3.1 Geology, soil and substratum

The dam is situated along a river course i.e. the Ngong-Motoine River and hence hydric soils of black cotton nature are predominant.

The soils are currently unidentifiable due to the current varying amounts and differing types of liquid effluents from upstream catchment pollution and the nearby Kibera settlement.

3.3.2 Vegetation

The dam is naturally supposed to have water friendly aquatic and sub-aquatic plants. The main natural plant species found in the wetland are mainly Typha domingensis papyrus and Cyperus sp with planted Napier grass in the surrounding

Evidently there are visible submerged and floating macrophytes with the more widespread and dominant being the now widely studied water hyacinth (Eichhornia crassipes). Water hyacinth, the grass and the other weeds grow luxuriantly and discussion with the nearby community residents revealed the vegetation acts as foliage for their livestock especially the grass as cattle feed. The water hyacinth has rapidly spread and covered the water that is supposed to be the Dam.

According to researches documented in the past by UNEP in 2004 the water hyacinth can be used to produce organic animal feeds, pellets and salts that serve as supplements for livestock in the dairy industry.

According to a report done by UNEP in 2004, phytoplanktons are the main ingredients in the dam and are most prevalent, with diatoms and the blue green algae dominating the phytoplankton in the Nairobi Rivers (Motoine-Ngong river that feeds the dam included).

3.3.3 Animals, fish and bird species

The dam is home for multiple bird species that enjoy the varied insect life. During site visit by the researcher, thirteen different bird species were observed. These were but a

limited number comparatively in respect to the constrained observation time and conditions of the site visit.

These birds were observed to nest in the trees and natural shrubs around the dam. The plush reeds and the sprawling spread of the water hyacinth served as foraging grounds for insect and other feeding grounds.

Up to 1999 the dam was teaming with stocked fish mainly tilapia, Oreochromis spp, Catfish Clarias, Black bass, Barbus and Lebistes, (NRBP Phase II, 2003).

Interviews with the local residents revealed that the dam had a considerable stock of fish up to the year two thousand (2000) with Tilapia forming the bulk of fish available in the dam.

3.4 Research methodology

The methodology is an operational framework through which a study goes through to put certain facts in scrutiny so that their meaning is seen more clearly. This section gives the detailed process on how the research was conducted, outlining the methods employed by the researcher in data collection, procedures, measurement of the various parameters and analysis that was aimed at accomplishing the set out research objectives.

The first step was identification of the research problem. It was followed by reviewing related literature that gave a theoretical base for the study. The secondary data was as a result of this literature review and primary data was collected from the field based on the research objectives.

3.4.1 Data collection methods

3.4.1.1 Interviews

The study relied largely on key informant interviews using direct and structured questions and discussions. The field experience showed that response rate was good as local populace around the dam was cooperative in giving information and discussions revealed a deeper understanding of issues facing the dam. Though communication was a challenge for administration of questions to some of the respondents, the use of Swahili gave an even ground for exchange of ideas and elimination of insecurity and other risks that would have restricted the collection of

data from the field. Interviews held with the Ministry of Water and Irrigation and Ministry of Environment and Natural Resources officials gave wide scope of coverage area.

3.4.1.2 Observation

To evaluate anything, a physical outlook of events surrounding a study area must be taken into account. The study focuses on a physical and visible object which is the Nairobi dam. Observation of the dam physically gives the visible condition of the existing situation. Kothari (1990) observes that observation becomes a scientific tool and a method of data collection to a researcher when it serves as a base for a formulated research purpose. Observation in this study was used to enlighten the researcher on the physical condition of the dam, in terms of human interaction with its control, management and subsequent exploitation.

3.4.1.3 Survey and questionnaires

Survey is an approach designed to collect systematic explanation or description of existing phenomenon in order to explain or give an analysis of trends for a particular observable trend or trends. The researcher issued questionnaires to various respondents who were selected based on their living distance to the dam and a relatively long past experience with the activities taking place within and near the Nairobi dam.

3.4.2 Sampling process

A sample is sub-group of a population which in research is taken to represent the entire population or population views. The sample should not be too small to restrict the study or too large to over stretch the time of observation and other resources available. It should be optimum to fulfill the required efficiency, representativeness, reliability and flexibility. Sampling hence took a two sides approach: local and professional bodies

i) Six local residents on the Kibera side

ii) Six local residents on the Nyayo High rise estate side

iii) Six local residents on the southlands and dam view estates (3 per estate)

Each sides respondents were chosen through a simple random sampling method thus giving each resident (upon qualification on the basis of involvement and period they have lived next to the dam) an equal chance of selection.

Professional bodies sampled were

i) Local government representative(Nairobi City council)

ii) National Environmental Management Authority

iii) Ministry of Water (Water Resources Management Authority).

iv) Ministry of Environment and Natural resources

The researcher used a purposive sampling approach to enable collection of accurate data from administration of questionnaires. Ten respondents (six on the high rise side and three in dam view estate and one in southlands estate) were given the questionnaires to fill on their own (reason being that they had errands to run and requested the researcher to leave the questionnaire and pick them at a later date when completed) while the researcher took time to administer the other remainder of the questionnaires by asking the pre formulated questions in Swahili. This was mostly for the people directly in contact with the dam and Kibera residents who had limited time to take an in depth look at the questionnaires.

3.4.3 Administration of questionnaires

The questionnaires were addressed to

i) National Environmental and Management Authority

ii) Nairobi city council planning department

iii) Opinion leaders like the Nairobi Sub Aqua and sailing club

iv) Local residents living on the periphery of the dam.

CHAPTER FOUR

DATA ANALYSIS AND PRESENTATION

4.0 Introduction

In this chapter, the researcher analyses the data collected from the respondents in field. The researcher examined the physical status of the Nairobi dam with a view of establishing the human effects influencing the management of the dam. With this in mind the researcher formulated a means of carrying out the study meant to equip the management of wetlands with an overview of management of urban wetlands and riparian zones. The findings create a base on which the analysis is carried out.

4.1 Respondent characteristics

Figure IV: Age of respondents

	Kibera		High rise		Langata dam view estates		**Perc Tota**
Age bracket of respondents	Number of respondents	Percentage	Number of responden ts	Percentage	Number of respondents	Percentage	
26-34	1	5.56	2	11.11	1	5.67	22.2
35-45	2	11.11	2	11.11	2	11.11	33.3
46-54	3	16.67	2	11.11	1	5.67	33.3
Over 54	0	0	0		2	11.11	11.1
Total	6	**33.3%**		**33.3%**		**33.3%**	**100**

Figure V: Years that respondent households have resided near the dam

	Kibera		High rise		Langata dam view estates		**Perce Total**
Years resided near the dam	Number of respondents	percentage	Number of responden ts	Percentage	Number of responden ts	Percentage	
5-10	1	5.67	6	33.33	2	11.11	50.00
11-15	2	11.11	0	0	1	5.67	16.67
16-20	2	11.11	0	0	2	11.11	22.22

Over 20	1	5.67	0	0	1	5.67	11.11
Total	6	**33.3%**	6	**33.3%**	6	**33.3%**	**100%**

Figure VI: Sex of respondents

	Kibera		High rise		Langata dam view estates		**Percentage Total**
Sex:	Number of respondents	Percentage	Number of respondents	Percentage	Number of respondents	Percentage	
Male	5	27.8	3	16.67	4	22.22	66.67
Female	1	5.67	3	16.67	2	11.11	33.33
Total	6	**33.3%**	6	**33.3%**	6	**33.3%**	**100%**

Figure VII: Household sizes

	Kibera		High rise		Langata dam view estates		**Percentag Total**
Household sizes(in no.s)	Number of respondents	Percentage	Number of respondents	Percentage	Number of respondents	Percentage	
1-2	0	0	1	5.67	1	5.67	11.11
3-4	1	5.56	2	11.11	2	11.11	27.89
5-6	2	11.11	3	16.67	2	11.11	38.88
Over 6	3	16.67	0	0	1	5.67	22.22
Total	6	**33.3%**	6	**33.3%**	6	**33.3%**	**100%**

4.2 Status of the dam

4.2.1 Pollution and settlement

It was observed that the dam water is literally/virtually non existent. The water surface is invisible and water hyacinth is covering the water surface, with a lot of solid waste on the upper side.

Plates: 1

Plate: 2

Eichhornia crassipes (water hyacinth) on the upper zone of the dam, Solid waste, plastics and waste water pollutants dominating surface of the dam

Source: Field Survey 2008

The other parts have homes, as well as overgrown reed beds. Agriculture is the dominant activity with napier grass, sugarcane and arrow roots taking the larger extent while kales and horticulture occupies the rest of the area that is not under wild vegetation.

Plates: 3

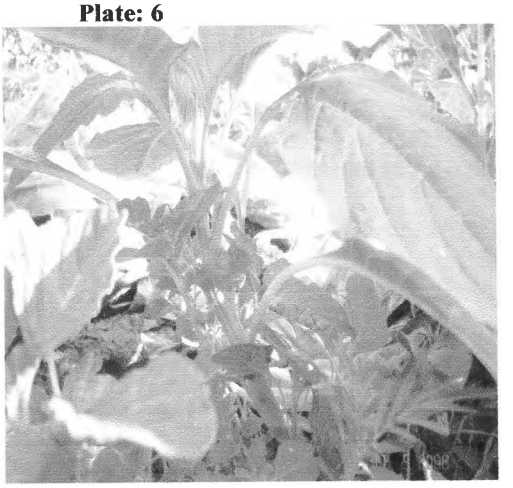
Plate: 4

Arrowroots and Napier grass growing on one side of the dam as wastes form the substrate

Source: Field Survey 2008

Plates: 5

Plate: 6



Homes on the riparian bank and a crop of healthy tomato and other leafy edible vegetable

Source: Field Survey 2008

Plate: 7

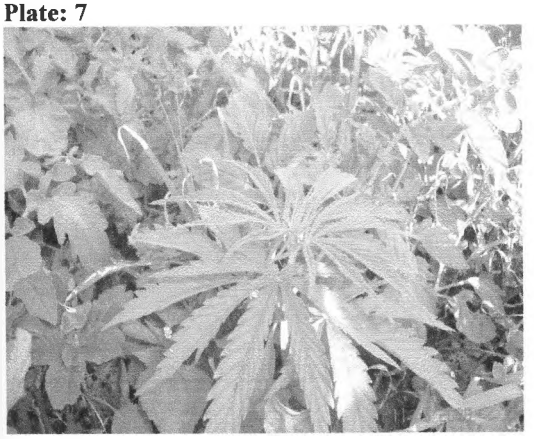


Plate: 8

Plate: 9

Plate: 10

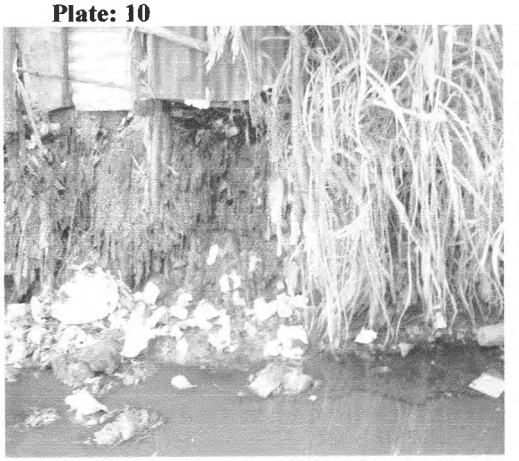


Plate 7: A cannabis sativa (bhang) plant growing within a tomato crop field

Plate 8 & 9: Hazardous clinical wastes of drug vials and needles on the dam that raises eyebrows as children were seen to play barefoot on these areas

Plate 10: Toilets empty their wastes directly into the water

Source: Field Survey 2008

The field survey revealed that the dam is polluted with a wide spectrum of wastes ranging from domestic, vegetative, human, industrial, chemical, clinical, as well as electronic ventures.

4.2.2 Human activities

When the researcher visited the study area, it was teeming with human activity ranging from women collecting vegetables from the dam, to the periphery of the edge at which the men were slashing weeds and clearing new areas in readiness for planting. Human activities around the Nairobi dam wetland revolve around subsistence farming of vegetables, sugarcane and arrow roots among other food crops.

Some of the activities are listed here below with a tally of the persons

- Clearing and slashing_12 people(men and women)
- Harvesting arrowroots_4 women
- Planting sugar cane _4 men
- Solid waste dumping _2 people(man and woman)
- Foraging for vegetables _3 women
- Planting kales and tomatoes _13 people(men and women)
- Harvesting kales_2 women
- Cutting and transporting napier grass _3 men
- Students at St Gabriel School (11 in number) were also planting onion seedlings on beds located at the edges of the dam.
- Other activities included a group of vagrant youths smoking bhang (cannabis sativa) within the concealed vast bushes of the dam.

Source: field survey, 2008

Animals, fish and bird species

According to the interviews, the researcher found out that only mud fish and eels are currently found in the now brackish waters of the dam and are mostly caught in the peripheries of the dam where the water hyacinth abates during heavy downpours

upstream that increase the volume of the dam to a level enough to create some spaces within the water macrophytes.

A hedgehog and squirrels were sighted and were an evidence of existence of small wild animals in respect to inability to access the deeper heavily reeded part of the wetland. Goats were seen grazing freely along the dam edges on the inlet side of the dam.

4.2.3 Commercial developments

The other visible element is the occurrence of new high rise estates on the periphery of the dam as well as on the riparian reserve of the dam. The estates are taking advantage of the reed concealment to dump raw waste as well as solid household wastes directly into the dam.

Plate: 11

This estate under construction is directly on the dam as the water action on the wall is well visible as well as the sinking and bending of the entrance column and hydric plants in the foreground
Source: Field Survey 2008

This shows that despite planning, building on sensitive areas is ongoing.

Plates: 12

Plate: 13

Plate 12: This might be mistaken for a river but in real sense is a waste water outlet from southlands estate.

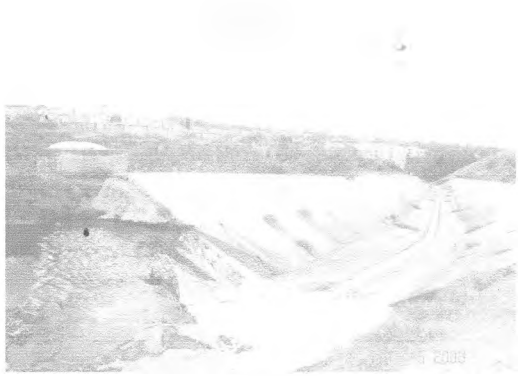
Plate 13: The solid wastes were below the Nyayo high rise upper edge, with majority of the wastes identified as packaging by large marketing companies e.g. Uchumi, Tuskys and Nakumatt whereas sugar, milk and plastic water/soda bottles formed the other remainder. Source: Field Survey 2008

4.2.4 Evidence of management

There were traces of new developments like the construction of a gabion and removal of some solid wastes to form a simple embankment on the Silanga stream inlet. The study also revealed the presence of an embankment that confines the dam's water outlet to a single channel river on the outlet side that is constricting the dam's water outflow thus controlling spread of the water hyacinth through outflow.

Plate: 14

Plate: 15



Meshed gabion recently constructed to control storm water carrying waste inflow and a concreted out spill that is in a good working condition.

Source: Field Survey 2008

4.3 Stakeholders in the management of Nairobi dam

The first objective of the study was to identify the stakeholders in the management of the Nairobi dam. The study established that there are various persons (both real and legal), or groups of persons who have a role to play in the management of the Nairobi dam. The study gives a collection of the current and main parties identified, thus subject to revision in future studies as more and more groups get registered to foster the well being of the dam.

4.3.1 Ministry of Water and Irrigation

This is the main policy formulating arm of the government during any formal process of strategy formation on ground water issues as well as financial planning on the administration of all water bodies vested in the state. The latest formulation is the Water Act (2002) published in the Legal notice number 8 of June 2002. The Act in Section 11 stipulates that following public consultation, the Minister shall formulate, and publish in the Gazette, a National Water Resources Management Strategy in accordance with the way water resources of Kenya shall be managed, protected, used, developed, conserved and controlled. The study found out that the Wetland department in the ministry of water dealing with wetland was directly responsible for all issues concerning wetland planning.

4.3.2 Water Resources Management Authority

This is the technical arm of the Ministry of Water as established from the Water Act (2002) under section 7: (1) establishes of an authority known as the Water Resources Management Authority to be a body corporate with perpetual succession and a common seal to have power, in and by its corporate name, to sue and to be sued and, in the exercise and performance of its powers and functions, to do and permit all such things as may lawfully be done or permitted by a body corporate in furtherance of its objects. The powers and functions of the Authority are exercised and performed under the direction of a governing board, consisting of a Chairman, appointed by the President of the Republic of Kenya; and Ten other members, appointed by the Minister in charge of the Ministry of Water.

The authority under section 8.1(f) is mandated in practice to among others:

- Manage and protect water catchments.

- Determine charges to be imposed for the use of water from any water resource in accordance with guidelines in the national water resources management strategy.
- Gather and maintain information on water resources and from time to time publish forecasts, projections and information on water resources
- Liaise with other bodies for the better regulation and management of water resources
- Advise the Minister concerning any matter in connection with water resources
- Undertake the prosecution of any offences arising under the Water act of 2002 with the consent of the Attorney-General given under the Criminal Procedure Code.

4.3.3 Ministry of Environment and Natural Resources

This is a Ministry created to foresee the administration of resources that are non-renewable and whose use, control and exploitation requires a regulating body. It previously encompassed water but currently it has been separated to create a new water ministry.

The study revealed that this ministry currently does not deal with wetland resources but in the past it had a wetland resource sub-department that occurred under water resource department. But on the general it deals with the environmental issues facing Kenyans and is now key in the debates on plastic wastes that are gagging resources and harming multiple flora and fauna in our environment.

4.3.4 National Environmental and Management Authority

This is an authority enacted under statute that was created to deal with environmental matters of Kenya and was established under Section 7 of EMCA as a corporate body with perpetual succession and a common seal with the capacity of suing and being sued, taking, purchasing, charging and disposing of movable and immovable property, borrowing money, entering into contracts, and doing or performing all such other things or acts for the proper administration of Environmental Management and Co-ordination Act, as may lawfully be performed by a corporate body, with its headquarters in Nairobi.

The main function of the authority is to exercise general supervision and co-ordination over all matters relating to the environment and acting as the principal instrument of Government in the implementation of all policies relating to the environment. The EMCA further provides that the authority in its practice shall:

- Co-ordinate the various environmental management activities being undertaken by the lead agencies and 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 a sustainable yield basis for the improvement of the quality of human life in Kenya
- Take stock of the natural resources in Kenya and their utilization and conservation.
- Establish and review in consultation with the relevant lead agencies, land use guidelines.
- Examine land use patterns to determine their impact on the quality and quantity of natural resources.
- Carry out surveys which will assist in the proper management and conservation of the environment.
- Advise the Government on legislative and other measures for the management of the environment or the implementation of relevant international conventions, treaties and agreements in the field of environment.
- Advise the Government on regional and international environmental conventions, treaties and agreements to which Kenya should be a party and follow up the implementation of such agreements where Kenya is a party.
- Undertake and co-ordinate research, investigation and surveys in the field of environment and collect, collate and disseminate information about the findings of such research, investigation or survey.
- Mobilize and monitor the use of financial and human resources for environmental management.

- Identify projects and programmes or types of projects and programmes, plans and policies for which environmental audit or environmental monitoring must be conducted.
- Initiate and evolve procedures and safeguards for the prevention of accidents which may cause environmental degradation and evolve remedial measures where accidents occur.
- Monitor and assess activities, including activities being carried out by relevant lead agencies, in order to ensure that the environment is not degraded by such activities, environment is not degraded by such activities, environmental management objectives are adhered to and adequate early warning on impending environmental emergencies is given.
- Undertake, in co-operation with relevant lead agencies, programmes intended to enhance environmental education and public awareness about the need for sound environmental management as well as for enlisting public support and encouraging the effort made by other entities in that regard.
- Publish and disseminate manuals, codes or guidelines relating to environmental management and prevention or abatement of environmental degradation.
- Render advice and technical support, where possible, to entities engaged in natural resources management and environmental protection so as to enable them to carry out their responsibilities satisfactorily.
- Prepare and issue an annual report on the state of the environment in Kenya and in this regard may direct any lead agency to prepare and submit to it a report on the state of the sector of the environment under the administration of that lead agency.

These form the basis of operation for NEMA and give the legal guidelines for the management of the environment in Kenya.

4.3.5 United Nations Environmental Program (UNEP)

This is an international organization that deals with international matters of environmental concern globally. It has its Africa headquarters in Nairobi and currently holds a key role in the clean-up of the Nairobi Rivers, one of which (Motoine river) forms the main water source for the Nairobi dam. The role of UNEP is felt through the Nairobi Rivers Basin Initiative which is an initiative funded and run by UNEP. The initiative is one among the many approaches created to redress the situation of the Nairobi Rivers under the leadership of Henry Ndede who is UNEP's environmental point man in the case of Nairobi dam.

In practice UNEP carries out a direct management process that includes:

- Preparing the projects documents
- Assessing and preparing revisionary project requirements
- Authorizing cash advance/ sub allotment and review of expenditure
- Monitoring management project implementation
- Control and manage non expendable systems
- Review monthly activities, accounts and take the necessary action
- Responding to queries on all aspects of the project and carry out audits of the projects
- Prepare project reports.

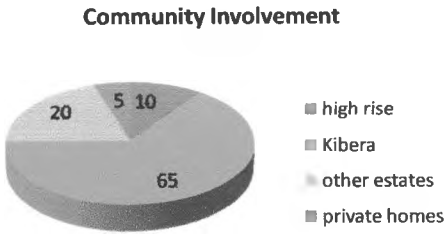
4.3.6 Local neighbourhood citizenry

The dam is located at the confluence of three major local people settlement regimes namely

1. Kibera informal settlement
2. Lower Langata private estates
3. Organized Nyayo high rise estates

The interviews held with these three diverse regimes produced three modes of thought but one fact was unanimously agreed upon; the dam was in need of a dire make-over. Their levels of engagement with matters of the dam also tended to vary from physical control to actual use of the dam.

Figure VIII: Community involvement levels



Source: Field Survey 2008

This disparity arises because of income levels where people in Kibera are more engaged in the activities of managing the dam to further their food and financial resources, while the more affluent private estates and homes are least concerned as all they needed according to the research was fresh air and a scenic beauty of the dam. It was quite evident that the estates wanted to have the dam in place as a form of security barrier from the sprawling Kibera informal settlement.

The security threat of the residents of lower Langata estates was voiced with a touch of the post-election violence that was widespread in Kibera and they had fears of spill over to their residential premises. This was mostly because the residents of Kibera could literally "walk" on the dam to them.

The research identified that the substrate occurring on the dam is as a result of under trapping of plastic waste by the water hyacinth that caused a heavy depository condition of silt and soil from the upper agricultural catchment area of the river that feeds the dam, whereas the plastic wastes were from the vast Kibera settlement area as well as other surrounding estates that have recently been springing up.

Plate: 16

A dense forest of green thready vegetation on top of the water is the only barrier between Kibera settlement area and Langata south estates as seen in this plate

Source: Field Survey 2008

4.3.7 NCC's Department of Environmental Management

Urban matters of Nairobi city are addressed in two ways through the central Government, and Local Government. The Nairobi City Council is the local government representative. Currently the central government is represented by the Ministry of Nairobi Metropolitan Development. The Local Government Act cap 265 gives mandate to the NCC powers to plan for the various areas as well have powers to provide water to the residents of the city. When the management of water supply became inefficient the mandate was delegated to the Nairobi Water and Sewerage Company. The NCC takes the environmental management issues seriously but as the researcher identified, past financial quagmires within the Council put Environmental management budgetary allocations to minimal amounts. It was this reason among others that caused a limitation in involvement in the management of the Nairobi dam.

4.4 Management

The Nairobi dam is a wetland that as a water body vests in the government. The study revealed that it gives the dam a 'public property' clause that results in the conflict of management activities. The research identified a multi party

involvement situation where the water regime falls under the water resources management authority but the land is under the commissioner of lands. The physical environmental well being of the dam is under National Environmental Management Authority, and the urban planning regime for the dam is in the domain of the Nairobi City Council as it is the body vested with powers to plan and approve regional physical plans. Previously the dam was under the Ministry of Environment and Natural resources.

The United Nations Environmental Programme takes much of the management obligations as the Nairobi River initiative is the most close to current issues facing the dam. Non governmental organizations like Friends of Nairobi dam Association (F.O.N.A) take the financial management of the dam affairs.

The transfer of information from the various government stakeholders is impossible as records are manual, the use of electronic database management is restricted and hence friction in the management activities.

Table II: Summary of issues of management identified

Issue	Impact	Management Redress measure
Poor soil management in head waters of the water source	• Sedimentation of wetland waters • Water pollution • Eutrophication • Water turbidity	• Introduction of Basin soil conservation authorities • Introduction of newer coil erosion control measures
Discharge of industrial, human and other waste into the dam	• Microbial water contamination • De-oxygenation and eutrophication combined with algal blooms in the dam • Physical matter pollution of water	• Introduction of alternative waste disposal mechanisms e.g. sewer and pre-treatment ponds • Removal of homes and toilets on riverine areas • Removal of

		physical matter
Invasive weeds e.g. water hyacinth	• Choking the water surface • Removing water oxygen • Killing fauna in water e.g. fish	• Introduction of bio-control e.g. Neochetina spp weevil
Introduction and poor use of agro-chemicals into the dam	• Increase in water nutrient level and subsequent growth of invasive weeds	• Minimise use on and around the dam and its riparian reserves
Stakeholder stratification	• Duplication of efforts • Loss of synergy • Poor management of the dam	• Bonding and integration mechanisms to bring on board all stakeholders

Source; Field Survey 2008

4.4.1 Thematic management areas

The second objective of the study was to identify and reveal the current management practices of the various stakeholders that the study would identify and who have been discussed above. The researcher conducting the study went through the various schemes tabulated in the various stakeholder action plans, documents and mandate papers and related them to the situation on the ground at the Nairobi dam. The aspects that were observed taken as were are related to Nairobi dam issues that act as an evaluation basis for this study.

1 Resource development

This is an area on the dam that is non existent. The dam is under no resource development funding and the only researches as the research established was by non concerted private individuals on their own. For any resource to continue serving its purpose, continuous investment in its development is cited as necessary.

2 Resource protection

The Nairobi dam is next to a high density settlement area of low and middle income regime. Any management activity is geared to ensuring that the dam continues to exist facing no threat of human invasion. Currently, there are homes, waste disposal areas, agricultural activities and multiple human activities on and around the dam. The riparian reserve is a hub of agriculture ranging from domestic crops like maize and beans to commercial crops like sugarcane meant for the Nairobi market. The legal protection of the dam is non existent as the invasion is currently ongoing.

3 Project financial management

The Nairobi dam rehabilitation is pledge funded by the government of Kenya. Other funds are sourced from international partners (donors) as well as local donation kitty that is as a result of efforts by concerned welfare groups like FONA. In order to carry out management of the area, money has to be well budgeted as well as used prudently to solve issues on the ground and this is an area where the research identified that there was no specific financial management of the monies raised for the dam.

4 Neighbourhood characterization management

The dam occurs in an area where people live. Its management takes a social dynamic impetus to create a viable and socially acceptable working environment. The research found out that the dam's management has no identifiable social affiliation management to the society and people living around it.

5 Stakeholder harmony management

All parties involved in a resource management are basically supposed to operate on the same slate with an understanding of what the other is doing and common areas are identified. The management of Nairobi dam is fragmented such that unless the activities are on national television, newspaper or radio, it remains unclear and unpublished what an entity does in the management of the dam. The local residents think the management of the dam is the duty of the state, the local authority, Nairobi City Council, has delegated water issues to the Nairobi water and sewerage company which inherited the difficulty of managing the urban water regime and the NGO's like the UNEP have undefined but generally restricted impact on the management of the dam. According to the interviews

conducted by the researcher, the only area the NGO's have an impact is public awareness and facts on the ground showed that the amount of publication is limited to board room meetings that have restricted trickle down effects to solve the crisis on the dam.

6 Catchment zone management

The catchment zone of the Nairobi dam is a stretch of a wide area that encompasses hard surfaces, human settlements and upstream riverine area. The management of non point pollution is mainly a catchment zone committee activity. The headwaters of the Nairobi dam are not managed as the research identified a heavily polluted Motoine river the main source of water for this urban wetland.

Plate: 17

The headwaters here are black due to the heavy wastes collected upstream.

Source: Field Survey 2008

7 Integration and synergy activity management

Wetlands are activity oriented areas in management where one factor directly or indirectly influences the others. A flood upstream no matter how tiny will result in a visible difference in wetlands downstream. A change in legal standing will affect management with a visible change. Stakeholder activity on the other hand will tend to compliment or thwart each others activity progress. The dam has no synergetic activity management.

4.5 Constraints of management experienced by the various stakeholders

The third objective of this study was focused on the areas which the above identified stakeholders were exposed to in the management of the dam. The study found out the following issues.

I. Local citizens/neighbouring community groups & members

a. 72% of the total people within the neighbourhood community interviewed complained that they only got involved in issues of the dam whenever the government officials came to 'photograph' the dam and no more. This resentment was voiced by 100% of Kibera residents who according to the field survey were the greater population in direct contact with the dam. The other 28% of the respondents were indifferent to getting themselves involved in a round table stakeholder consensus building on management of the dam. 100% of Kibera respondents were found to give the same response that their contribution and effort in managing the dam was not sought by other stakeholders like the central and local government.

b. 84% of the residents interviewed admitted that they had limited financial capacity to manage this wetland in a sustainable way. This was also evidenced by lack of basic services and infrastructure. The remaining 16% insisted that the government was the sole funding agency thus had unwilling to contribute financially to any drive geared towards the management of the dam.

c. Sealing off of the dam by more affluent groups. This makes difficult any activities that can be carried out on the dam from those fenced sides.

d. Continuous building on the dam. It was peculiar to observe that the Kibera residents had set up a certain limit beyond which no other houses could be built yet the Langata side had new estates constructing right to the edge of the dam.

e. 94% of the total respondents served with questionnaires were exposed to none or limited information and awareness on the current government plan of activities in the dam's management and conservation. This tended to make the various groups hesitant do any contributions towards the management of the dam as they did not know what the next government directive would be.

f. Lack of inclusion in the various management geared initiatives like the formation of wetland operational working papers as they tend to ignore indigenous skills that are held by people who have no formal education of high level.

II. Central and Local Government Ministries and Departments like NEMA, WRMA & NCC

a. The various officials interviewed felt that their main problem in managing wetlands was lack of a central body whose duties of wetlands fell upon and whose main and specific area was managing wetlands in Kenya like the way Nairobi Water and Sewerage deals with supply of water to Nairobi.

b. The condition that if a person dealing with wetlands gets transferred to other departments, or leaves the position there remains an information gap as dissemination modules are ineffective.

c. The coordination between the various government offices on the activities of wetlands and the Nairobi dam in specific was highly constrained as there are bureaucracies in all organizations where integration is not central in their operations.

d. Limited information on management of wetlands as the various manual databases are out of date, cadastral maps of wetlands are non-updated and there exists a general lack of passion to pursue electronic management information systems.

e. There is general constricted supply of funds for managing urban wetlands but the creation of the Nairobi Metropolitan Ministry gives an opportunity to create a funding module for management opportunities on the water surfaces of wetlands in Nairobi.

III. Non Governmental Organizations like UNEP& FONA

a. The organizations experience limited governmental support as their budgets are constrained as they depend on donations to run their management activities.

b. Difficulty in acquiring enforcement capacity in implementing their various management activities that can be seen as injuring the welfare of the settlement on the dam while in the pursuit of environmental conservation

c. Negative perception by people on the grass-roots as that of promoting their own goals at the expense or neglecting that of the people on the actual areas where their activities are implemented.
d. Lack of electronic data and information connectivity means to other stakeholders engaged in managing the dam.

4.6 Hypothesis testing

The research hypothesized that lack of adequate management is the cause of the current state of the dam. Findings of this research revealed that the dam is polluted, the dam water quantity and quality has subsequently reduced. Agriculture is taking over the dam reserves while buildings are coming up right on the dam periphery and limited management activities were observed to exist on and around the dam. The hypothesis was true.

Table III: Causes of the above status of the dam

	Kibera	High rise	Langata dam view estates	**Average percentage of reason**
Reason	Percentage	Percentage	Percentage	
Lack of finances	50	33.3	33.33	38.88
Lack of adequate management	33.3	33.3	66.6	**44.44**
Lack of stakeholder cohesion	66.67	16.67	16.67	33.33
Lack of enforcement of law	33.33	33.33	33.33	33.33
Others	16.67	33.33	66.67	38.88

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

The Nairobi dam poses a wide variety of opportunities to institute management changes, for all the stakeholders within the existing laws and regulations. This includes Government of Kenya resource and regulatory agencies administering the existing programs. The modifications suggested here-in will augment the current legislations as they are recent and are sufficed to only address specific wetland sector issues.

The study's main findings were that;

1. The dam is currently polluted, most of the pollutants being human and plastic wastes,
2. There were more than one stakeholders involved in the management of the dam,
3. Stakeholders efforts were uncoordinated and thus conflict of management efforts,
4. The local neighbourhood community members were given least position in management discussions and actual management of the dam,
5. Financial constraints faced the stakeholders in running affairs of managing the dam.

5.1 Discussion of findings

Management of wetlands is a major area of concern. Poor management is the cause of much wetland malfunctionality in our human living space. The study evidenced that Nairobi dam is polluted by both vegetative factors point& non-point human wastes in form of solid and liquid effluents that under proper management modules, would be possible to eliminate.

The plastic waste debate that is ongoing is deemed to give a light to urban solid waste problems that are blamed for the large amount of floating matter on the dam. The

presence of hazardous chemical and clinical material on the dam is an issue of ethical waste disposal mechanisms for this kind of waste.

Management of the dam is a basin wide issue. The dam occurs within a series of river patterns. Having regard that the dam occurs in the middle of a human settlement area, the consideration of human dynamic aspects may give management of the dam some light in restoring a scenic view, a potable water source, and a source of economic empowerment. This can be done with, for and by the inclusion of residents in Kibera settlement area through restoring the environmental functions of wetland ecosystem into operation.

Researching into wetland development as revealed by the study is not being carried out as is supposed for all development goals. Upon exploration, it can give a good ground for pursuit of newer and locally viable mechanisms of managing urban wetlands coupled with scholarships to further the available pool of information on the management of environment and wetlands in specific.

The lack of an electronic information system to collect together and make easy the dissemination of information on wetland conservation matters is an area constricting the necessary flow of information that creates synergy to enable pooling of information over the dam and other wetland resources.

Ramsar convention sites in Kenya concentrate on touristic lakes and reservoirs like the Naivasha and Nakuru lakes and regard for smaller urban waters which could form equal or greater tourist sites due to accessibility are given limited exposure and consideration.

5.2 Conclusions

1. Management is a multi-stakeholder avenue whose impetus is that of constantly addressing issues of human and natural assets without whom, dire consequences are bound to occur. Management can only be possible if government policy analysts and practitioners first assess the realities of the dam's social, economic, and political condition before designing any intervention. Wetland management institutions and policies should be a reflection of these political, physical and social realities.

2. Currently, it is assumed that once you decentralise water management responsibility to the river basin, sub-catchment, and to water user groups at the lowest levels, effective dialogue and participation will automatically occur. This is not necessarily true and the management of the dam does not adhere to theories on paper rather it dwells on its own social stratosphere that is dynamic and to which management must seek to actively engage for any purposeful furtherance of its goals.
3. Stakeholder analysis and balancing the importance of long-term planning for water management with the need to address the urgent, and understandably impatient, concerns of the poor will be a significant challenge for managing urban wetland and riparian reserves.
4. The principle of 'polluter pays' only applies to 'commercial and industrial' organizations who constitute a very small section of the society. The larger section of urban poor people like in Kibera cannot pay and won't pay.
5. Formalized water management institutions do not promote widespread stakeholder participation and in some instances, contradict the central premise of widespread stakeholder participation by excluding the urban poor.
6. Getting the diverse parties to the negotiating table is one thing, but getting them to fully and meaningfully participate is something else.The importance of dialogue in the creation of an enabling environment for genuine stakeholder involvement should seek contribution from people living closest to the resource. The dam is mostly under the Kibera residents' exposure hence ministry officials in their policy creation should take them on board and get them to actively engage in the management of the dam.
7. Management is an interdisciplinary human activity that touches on all aspects of the dam, from its planning, use or misuse, control, exploitation, condition, to protection and conservation. It gives the impetus for the urban community to appreciate citizen participation on resource management, from the levels of decision making, total control, collaboration, consultation, delegation of power, partnership, respondent, informative, and as voter constituent.

8. Though the planning and resource agencies like NEMA and Local Authorities are familiar with wetland issues, the degree of knowledge concerning wetlands at other agencies varies and often, individuals who possess this knowledge do not pass it on when they leave their position. There presently exists no formal mechanism(s) within some agencies which assure(s) that wetland regulations will be enforced or followed when the constantly and effectively.

5.3Recommendations

5.3.1 Regulatory and Administrative Alternatives

Evaluate, publicize and enforce the current regulations which currently affect activities impacting urban and peri-urban wetlands, the following alternatives can be considered:

5.3.2 Governmental Institutions Management Alternatives: NEMA, NCC

The following areas suggest improvements to more clearly define agency functions and personnel requirements in management of wetlands in a better way away from the current management shortcomings:
The GoK and the parliament can institute the writing of new Wetland Rules and Regulations. These will serve to maintain a complete and independent Kenya's wetland law, that puts Best Management Practices of wetlands as an integral part of wetland use and as a part of a new land use plan. These laws and regulations can be entrenched in the EMCA and local authority by-laws. Amendments to the law and policy could include the following:

- The decision, to issue (with or without conditions) or deny the permit, should be made by the NEMA in conjunction with other resource management agencies in consultation with knowledgeable experts and with public input. This can be improved through reviewing decision making authority from NEMA by a technical permit review that liaises with NEMA.
- Require strict wetland and general environmental protection measures to be undertaken during construction around wetlands.

- Require honest analysis of all management alternatives in order to qualify any activity that may adversely affect wetlands. This will include recommendations made by NGO's and other stakeholders.
- Provide clear, strict environmental assessment standards for wetland areas which accurately describe the existing wetland values and functions.
- Provide wetland mapping and delineation standards including delineators' qualifications, mapping standards, and time frame of validity of the resultant map work that gives management a clear job description and a scope of operations.
- Require that impact mitigation plans be simple and attainable, and include a public education component, monitoring, reporting, and a list of developer responsibilities. This will go a long way in easing the management activities on wetlands and riparian reserves.
- Enact a permanent Kenyan Wetland Endangered Areas law which can include protection/conservation requirements for degraded and potentially threatened wetlands.

  Local Authority level whose responsibilities include, though are not limited to, wetlands; inspection of construction sites and public works near or next to wetlands to assure that unpermitted activities are not taking place in wetlands, thus giving assurance that wetland violations are not made by agency (including contractors) when constructing and maintaining private or public property or infrastructure.
- Draft and enforce a set of wetland specific water quality standards by the Ministry of Water and Nairobi City Council that recognize a more complete range of wetland functions. This will direct the management of wetlands to a betterment objective as standard compliance ensures measurability of management objective and especially for an urban wetland like the Nairobi dam.
- Consider the establishment of a formal Memorandum of Agreement between the National Environmental Management Authority and the stakeholders involved in the wetland issues of Nairobi dam to clearly define and balance the burden of work between the various parties as well as agencies.

- Giving equal standing to all lakes and dams in terms of Ramsar convention requirements that removes the notion of 'lesser' or 'greater' lakes or water bodies.
- Creation of river basin authorities that oversee the management of wetlands occurring on and around the riverine areas.

5.3.3 Neighbourhood Residents management alternatives

1. Create tax reductions and other incentives for protection of wetlands on private properties abutting the Nairobi dam and other wetlands of national importance.
2. Explore the feasibility of a land exchange program (with Kibera Laini Saba residents occupying land next to the dam and its riparian reserves to enable moving away for those who qualify) for small property owners who presently have no other option but to develop wetland areas for single family construction and existence. This program must discourage settlement on the riparian areas and promulgate local resident participation in deciding the course of action in management of the dam.
3. Get more involved in awareness activities that other stakeholders are doing.

5.3.4 Non Governmental organizations like UNEP

Establish an environmental management scheme of integration to other stakeholder activities answering the call of synergism in pooling together of resources directed towards management of the dam.

5.4 Limitations of the study

The study was carried out in high risk environment with the researcher being exposed to hostile environment. This limited the size of the sample as the results would have been more comprehensive for comparison and analysis if the study could have accessed more respondents. Another limitation was the time it took to acquire authorization to access documentation and relevant information from the various government offices. The constrained time available was not sufficient to get any meaningful information from Nairobi metropolitan Development ministry.

5.5 Areas of further study

The study took time to look at management in an overview level and specific groups involved in the management were analyzed in an empirical level. Further analysis of a single specific stakeholder(s) can be done. Other related areas of this study and which can be researched in detail could be:

1. Data sources for valuing economic losses of wetlands
2. The evaluation of the level and role of community involvement in management of riverine ecosystems in Kenya.
3. Identification of opportunities for linking local interests of residents around wetlands like Nairobi dam to national policy-making interests

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APPENDICES

Appendix 1:

Questionnaire to the house holds.

My name is Njue G.N, from the University of Nairobi conducting a research on Evaluation of management practices on wetlands and riparian reserves giving an emphasis on the Nairobi dam. The information given herein will be treated as confidential and for research only.

Name: .....

Household number: .....

Household size: .....

Male (_)

Female (_)

Instruction: (please select an option in the options provided)

1. How many years have you lived here?

.i) one month to one year (_)

.ii) two years (_)

.iii) Three years (_)

.iv) More than three years (_)-Specify.....years.

2. What is the distance of your household from the dam?

.....meters.

3. Have you in any way been involved with the Nairobi Dam?

.Yes .....

.No .....

3. What activity do you engage in?

.a) control: physical

.....

: Social

.....

: Financial

.....

: Other

(specify).....

.b) use : settlement around the dam (_)

: farming (_)

: fishing from the dam (_)

: Drawing water (_)

:other(specify).....

.....

.....

.....

.....

4. a) What, in your opinion are the problem(s) facing the dam?

.....

.....

4. b) What, in your opinion are the main causes of problem(s) facing the dam?

.....

.....

.....

5. How can the problems be addressed or solved?

.....

.....

.....

.....

.....

.....

6. Has you or the people living in this community been involved in any educative campaign promoting the well being of the dam?

: yes (_)

: No (_)

7. How would you rate the importance of the following stakeholders in dealing with the issues affecting the dam?

FACTOR:	VERY IMPORTANT	IMPORTANT	NOT IMPORTANT
Neighborhood Community involvement			
Nairobi city council involvement			
Ministry/Central government involvement			
Non Governmental Organization involvement			
International bodies e.g. world bank involvement			

8. What would you recommend for the Nairobi dam?

i).....

.....

.....

.....

.....

ii).....

.....

.....

.....

.....

Date: .....

Signature: .....

Appendix 2

Questionnaire to the City Council of Nairobi

Questionnaire to the Nairobi city council planning department

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My name is Njue G.N, a student in the department of real estate and construction management, University of Nairobi, conducting a research on an evaluation of management of wetlands and riparian reserves with a special emphasis on the Nairobi dam. The information given herein will be treated as confidential and for this research only.

Name: .....

Position held: .....

Requirement:

To fill the gap, please select option/options provided and/or give a comment where necessary or where prompted. Thank you.

1. Is the mandate of the Nairobi city council on environmental health management revealed in the Nairobi dam scenario?

   .yes (_)

   .no (_)

   .other

   (Specify).....

   .....

   .....

   Give reason(s) for the answer above

   .....

   .....

   .....

   .....

   .....

   .....

.....

.....

2. Does the role of water provision suite the management of the Nairobi Dam in pursuance of the powers vested in the council?

   .Yes (_)

   .No (_)

   .Don't know (_)

3. Are there any current plans that are in place for the management of this urban degraded wetland?

   Yes (_)

   No (_)

   Don't know (_)

4. Are there any standards, rules or regulations on the management of urban water bodies in Nairobi?

   Yes (_)

   No (_)

   Don't know (_)

   If yes, specify which

   one(s).....

   .....

   .....

   .....

   .....

   .....

   .....

   .....

5. Are the rules enforceable?

   Yes (_)

   No (_)

   Don't know (_)

6. Who enforces them?

   The council itself (_)

   The law courts (_)

   Subcontracted individual(s) (_)

   Don't know (_)

7. What is the role of the Council in integrating with the following bodies in managing the Nairobi Dam?

   .The ministry of water and irrigation

   .....

   .....

   The ministry of environment and natural resources

   .....

   .....

   The local neighbourhood community

   .....

   .....

   The Nairobi River Basin Initiative/Programme

   .....

   .....

   Friends of Nairobi Dam Association

   .....

   .....

8. How is the dam currently managed?

   . Full in-house management (_)

   .Partial in-house management (_)

   .Full subcontracted management (_)

   .Partial subcontracted management (_)

   .A mix of in-house and subcontracted (_)

   .Not managed (_)

   .Managed by the local residents (_)

.Don't know (_)

9. Does the Nairobi City Council envision a management scheme that can return the state of the dam to a functional condition?

   .Yes (_)

   .No (_)

   .Don't know (_)

10. Are there any financial methods in application for managing the dam e.g. tradable bonds on the conservation on the environs of the dam?

    .Yes (_)

    .No (_)

    .Don't know (_)

    If yes give illustration

    .....

    .....

    .....

    .....

11. Are there any constraints you as the Council faced in managing the Nairobi Dam?

    .Yes (_)

    .No (_)

    .Don't know (_)

    .If yes give illustration

    .....

    .....

    .....

    .....

    .....

12. In the management of a water body what does the Council recommend?

    .Use of local standards and by law measures

    .Use of internationally recognized regulations

    .Use of any available methods

.Don't know

.Others (Specify)

.....

.....

.....

.....

13. Does the Nairobi City Council use Best Management Practices on the Nairobi Dam?

.Yes

.No

.Don't know

14. Is the role of I.S.O 14000 standards well understood and applied on the management of urban resources like the Nairobi Dam?

Yes (_)

No (_)

Don't know (_)

15. Does the council have a monitoring and evaluation of its management functions in light of urban Environmental quality enhancement and control?

Yes (_)

No (_)

Don't know (_)

Date .....

Signature .....

Official stamp .....

Thank you.

Appendix 3:

Questionnaire to NEMA

Questionnaire to the National Environmental Management Authority

My name is Njue G.N, student from the University of Nairobi conducting a survey to find out and evaluate management of wetlands and riparian reserves, in the partial fulfillment of my degree course. Any information given herein will be treated in confidentiality and for purposes of this research only. Thank you.

Name .....

Position held .....

Required: please tick option(s) and give reason(s) where applicable

1. How is NEMA involved with the management of wetlands and riparian reserves?

   .....

   .....

   .....

   .....

2. Is the mandate of NEMA on environmental management tally to or is in line with the Nairobi dam scenario?

   .yes (_)

   .no (_)

   .Other

   (Specify).....

   .....

   .....

   Give reason(s) for the answer above

   .....

   .....

   .....

   .....

   .....

   .....

3. Are there any current plans that are in place for the management of this urban wetland?

Yes (_)

No (_)

Give

example(s).....

.....

.....

.....

.....

.....

4. Are there any international or local standards, rules or regulations being used in the management of urban water bodies in Nairobi?

Yes (_)

No (_)

Don't know (_)

If yes, specify which

one(s).....

.....

.....

.....

.....

.....

5. How would you rate the enforcement of environmental laws regarding human activities on wetlands especially the Nairobi dam?

Very Good	Good	Satisfactory	Poor	Absent(no enforcement)

6. What in your opinion are the constraints you face being involved in managing of urban wetlands and the Nairobi dam in particular?

.....

.....

.....

.....

7. Is I.S.O 14000 standards applied to the management of urban resources like the Nairobi Dam?

   Yes (_)

   No (_)

   Don't know (_)

8. Does NEMA have a monitoring and evaluation of its management functions in light of urban Environmental quality enhancement and control?

   Yes (_)

   No (_)

   Don't know (_)

9. What would you recommend for the Nairobi dam?

   .....

   .....

   .....

   .....

   .....

Date .....

Signature .....

Official stamp .....

Thank you.

Appendix 4:

Questionnaire to the Nairobi sailing club management

Questionnaire to the Nairobi Sailing club management

My name is Njue G.N from University of Nairobi conducting a research on evaluation of management of wetlands and riparian reserves with a special emphasis on the Nairobi dam. The information given herein will be treated as confidential and for this research only.

Name: ……..

Position held:……

1. How many years have you been with this club? ……years.

2. In your opinion, is there a relationship between the club and the dam management?

.YES (_)

.NO (_)

Reason(s) for answer above:

……

……

……

……

3. What is your view about the status of the Nairobi dam?

……

……

……

……

……

4. Is the management of the dam satisfactory?

.YES (_)

.NO (_)

Give reason(s) for answer

above……

……

……

5. What do you consider to be the main constraints to the management of the dam?

.....

.....

.....

.....

.....

.....

.....

6. How would you rate the importance of the involvement of the following stakeholders affecting the dam?

FACTOR:	VERY IMPORTANT	IMPORTANT	NOT IMPORTANT
Neighborhood Community involvement			
Nairobi city council involvement			
Ministry/Central government involvement			
Non Governmental Organization involvement			
International bodies e.g. world bank involvement			

7. Rate the options below and recommend any other interventions for the Nairobi dam?

	VERY IMPORTANT	IMPORTANT	NOT IMPORTANT
Mechanical clearing of debris			
Chemical clearing of vegetation			
Treatment point of			

wastes(effluents)			
Treatment of non point substances			
Fencing off the dam and the Ngong and Motoine rivers			
Advocating for privatization of the dam			
Modifying the dam through channeling or filling			

Recommendations

I)……

……

……

……

ii)……

……

……

……

……..

Date: ……

Signature: ……

Stamp: ……..

Appendix 5:

Satellite image of the Nairobi dam