IMPACTS OF HUMAN ACTIVITIES ON WETLAND RESOURCES MANAGEMENT AT NAKIVUBO WETLAND, KAMPALA-UGANDA

BY

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A RESEARCH REPORT SUBMITTED TO THE SCHOOL OF ENGINEERING AND APPLIED SCIENCES IN PARTIAL FULFILLMENT FOR THE REQUIREMENTS FOR THE AWARD OF A DEGREE OF BACHELORS OF SCIENCE IN ENVIRONMENTAL MANAGEMENT OF KAMPALA INTERNATIONAL UNIVERSITY.

JUNE, 2015

DECLARATION

I **BULONZA NYAKABASA**, do declare that this dissertation is my original work and has never been presented anywhere for any award in any other university or institution of higher learning.

Signature:..

Date:.........11/06/2015...

APPROVAL

This is to certify that this dissertation entitled ''Impacts of human activities on wetland resources management'' has been done under my supervision and submitted to the Department of Biological and Environmental sciences.

Supervisor; Mr. Omuna Daniel

Sign:...

Date: 11/06/2015

DEDICATION

This dissertation is dedicated to my father **Dr. Nyakabasa Bona** and my brother **Mr. Pacifique Nyakabasa** for the love and feel of belongingness, the courage they gave to me which has devoted me to the completion of this course.

ACKNOWLEDGEMENT

Whereas research is an individual task, I still believe however without any support from different people, it is impossible to accomplish successfully.

I would therefore acknowledge the almighty God for the strength, wisdom and understanding granted to me in completion of this course, my supervisor Mr. Omuna Daniel and all other lecturers who offered me guidance, support, and advice in the accomplishing the same.

I would like to acknowledge my class mate Mugomoka Masonga, who helped me in one way or the other in the accomplishment of this course through their cooperation.

I would also acknowledge my family members that are; John Nyakabasa, Bahati Bakuru, Neema Musimwa and my husband John Halisi Muhindo among others not forgetting my parents and who provided everything as far as this report is concerned. May God bless them abundantly! Also, I would like to extend my sincere thanks to my friends like Mugarura Alexander, Mugomoka Masonga, Nasra Muhammad to mention but a few for supporting me in various ways; may God bless them abundantly.

LIST OF ABBREVIATIONS

CRP	Conservation Reserve Program
EEA	European Environment Agency
EIA	Environmental Impact Assessment
EPA	Environment Protection Act
GDP	Gross Domestic Product
IRI	International Research Institute
IUCN	International Union for Conservation of Nature
NEMA	National Environment Management Authority
NGO	Non-Governmental Organization
PAHs	Polynuclear Aromatic Hydrocarbons
pH	Potential Hydrogen
SCS	South China Sea
UNEP	United Nations Environment Programme
UN-HABITAT	United Nations Human Settlements Programme
USDA	United States Department of Agriculture
USEPA	United States Environment Protection Agency

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ABSTRACT

Wetlands are defined as "areas of marsh, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water, the depth of which at low tide does not exceed six meters". Wetlands in Uganda cover some 30,000 km2, or about 13% of the country (Government of Uganda, 2001). Although almost all of the wetlands in the country are under threat in some way, those located in towns and cities face the perhaps the most intense pressures. Over the last decade Uganda has entered a period of rapid economic growth, rehabilitation and urban expansion. The population of the Ugandan capital city of Kampala has dramatically increased since the political turmoil of the 1970s and with it a considerable rise, uncontrolled human settlement and industrial development have exerted extreme pressure on Nakivubo wetland drainage system in Kampala urban district. This research focused on examining the impacts of human activities on Nakivubo wetland by identifying human activities practiced there, determining their effects and assessing the possible measures that can be carried out. Industrialization (19%) and waste dumping (19%) were pointed out as the most activities that take place in Nakivubo wetland and are considered to be the root causes of all degradation in this ecosystem.Water pollution (23%) was the most effect of human activities in Nakivubo wetland as a result of industrialization and waste dumping and water treatment (31%) showed up as the most measure available to help in reducing the effects of human activities on Nakivubo wetland which was said to be implemented by the government of Uganda at Ggaba water treatment plant and Bugolobi sewage treatment plant. Laws and policies (23%) alongside other measures was also a very influential measure in managing the wetland. Re allocation of people (5%) was the least measure practiced in the area and the respondents used a defensive language that it is not even the root cause of all evil; saying it is industrialization.

CHAPTER ONE

INTRODUCTION

1.0 Introduction

This chapter includes the background of the study, problem statement, and objectives of the study, research questions, scope and significance of the study.

1.1 Background of the study

Wetlands are defined as "areas of marsh, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water, the depth of which at low tide does not exceed six meters" (Mitsch&Gosselink, 2000). The frequent or prolonged presence of water at or near the soil (hydrology) is the dominant factor determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface. Wetlands can be identified by the presence of those plants (hydrophytes) that are adapted to life in the soils that form under flooded or saturated conditions (hydric soils) characteristic of all wetlands (Mitsch&Gosselink, 2009). Wetlands are found in a variety of topographical settings for an example gentle slope and depressions where water flows down to the river. The fresh water wetlands are found all over the world in lowland areas such as rivers, lakes and streams. They play an important role in purifying water by trapping pollutants, micro-organisms such as viruses and bacteria which cause diseases like diarrhea and dysentery. They function like living filters because they remove pollutant nutrients and sediments from surface and ground water (John Dini, 2009)

In the last century, over 50% of wetlands in the world have been lost, and the remaining wetlands have been degraded to different degrees because of the adverse influence of human activities (Fraser &Keddy, 2005). Wetlands harbor a large number of threatened birds, in addition to a variety of wildlife and are vital to their conservation. At least 20% of the threatened bird species inhabit wetlands in the Asiatic region which is far more than the 10% of the globally threatened brids (Kumar *et al.*, 2005). Out of 310 Indian wetland birds, 107 species are winter migrants (Kumar *et al.,* 2005). The wetlands of South Asia are facing tremendous anthropogenic pressure, which can greatly influence the structure of the bird community (Bird Life International, 2003).

Activities resulting in wetlands loss and degradation include: agriculture; commercial and residential development; road construction; impoundment; resource extraction; industrial siting, processes, and waste; dredge disposal; silviculture; and mosquito control (USEPA, 1994). The primary pollutants causing degradation are sediment, nutrients, pesticides, salinity, heavy metals, weeds, low dissolved oxygen, pH, and selenium (USEPA, 1994).

Many of South Africa's wetlands have been impacted by poor agricultural practices prior to afforestation, including overgrazing and indiscriminate burning of grasslands, soil erosion and drainage of wetlands for extended periods. It is estimated that development and poor land management have already destroyed over 50% of our freshwater wetlands. The continued destruction of our wetlands will result in the disappearance of these priceless wetland functions and values. (State of wetlands in South Africa, 2007)

Wetlands in Uganda cover some 30,000 km2, or about 13% of the country (Government of Uganda, 2001). Although almost all of the wetlands in the country are under threat in some way, those located in towns and cities face the perhaps the most intense pressures. Over the last decade Uganda has entered a period of rapid economic growth, rehabilitation and urban expansion. Already over 14% of the country's inhabitants live in cities, and urban populations are increasing at a rate of more than 5% a year – almost twice the average in rural areas (UN-HABITAT, 1999). There is a growing demand for housing and land for settlement, rapid construction is taking place, and industrial and commercial activities are increasing. To date, most of these developments have been implemented in the absence of proper planning and controls, and have involved wetland drainage and reclamation (NEMA, 1996). Nakivubo's characteristics and location means that it provides a unique and important set of services to Kampala's dwellers. It functions as a buffer through which much of the city's industrial and domestic wastewaters pass before being discharged into Lake Victoria at Murchison Bay (NEMA, 1996).

1.2 Problem statement.

The population of the Ugandan capital city of Kampala has dramatically increased since the political turmoil of the 1970s and with it a considerable rise, uncontrolled human settlement and industrial development have exerted extreme pressure on Nakivubo wetland drainage system in

Kampala urban district. The Ugandan government strongly encourages private investors and the growth of the industrial sector in an effort to promote value addition to locally produced items and subsequently discourage the export of raw materials on the international trade market. This has resulted in rapid increase in the number of manufacturing industries in the city, with little attention to their attendant effects on the environment. These industries have caused pollution of Nakivubo wetland and Lake Victoria which affects all species that depend on them and also people. A considerable degree of crop cultivation takes place on the wetland by unaware small-holding farmers, growing sugarcane, yams, coco- yams, sweet potatoes and a variety of other vegetables.

1.3 Objectives

1.3.1 General objective

To examine the impacts of human activities on wetlands resources in Nakivubo wetland

1.3.2 Specific objectives

The specific objectives of the study are;

i. To identify the human activities carried out in Nakivubo wetland
ii. To determine the effects of human activities on wetland resources in Nakivubo wetland
iii. To assess the possible measures that can be taken to reduce the effects of human activities on the wetland resources in Nakivubo wetland

1.4 Research questions.

i. What human activities are conducted in Nakivubo wetland?
ii. What are the effects of those activities on Nakivubo wetland resources?
iii. What conservation measures can be used to reduce the effects?

1.5 Scope.

Geographical scope

This research was based on Nakivubo wetland covering a surface area of 5.29 km^2, located in Kampala district central Uganda. Nakivubo wetland lies to the south- east of Kampala District where it borders Lake Victoria at Murchison Bay.

Content scope

This research was focused on examining the impacts of human activities on Nakivubo wetland by identifying human activities practiced there, determining their effects and assessing the possible measures that can be carried out.

Time scope

The study lasted for two months that is; May and June 2015

1.6 Significance of the study.

This research will act as a base line to academicians and future researchers, developers and politicians who might wish to use it. It will help me to get more knowledge about wetlands and water resources as it is on the ground and be able to make conclusions and recommendations. It will provide more knowledge to all other interested readers about the impacts of human activities on wetlands and water resources. Gaps left for the future researchers shall also be clearly identified.

It will help the developers to identify how their activities affect the environment. It will also help them to identify some conservation measures that could be used to conserve their wetlands and water resources and/or following the set environmental procedures like Environmental Impact Assessment (EIA).

1.7 Definition of key terms.

1.7.1 Impact

It is the action of one object coming forcibly on to contact with another.

1.7.2 Human activities

This refers to every effort man puts into action especially during exploitation of natural resources in the environment. Human activities include farming, mining, fishing, and transport among others

1.7.3 Wetlands

The National Water Act No. 36 of 1998 of South Africa defines wetlands as a land which is transitional between terrestrial and aquatic systems, where the water table is usually at the surface or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.

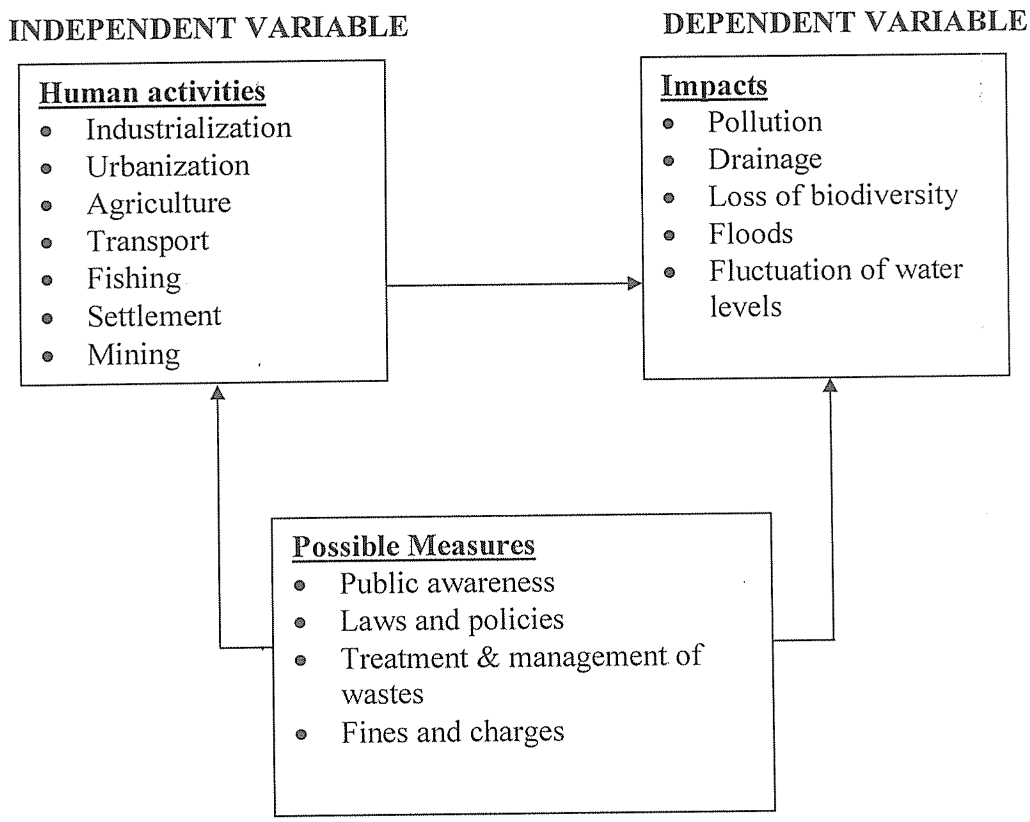
1.7.4 Resource

A resource is anything which occurs in the environment either naturally or artificially but can be used by man to fulfill his need. They include wetlands, soil, water and forests among others.

1.7.5 Management

This refers to any human initiatives directed towards sustainable utilization of the environmental resources.

1.8 Conceptual frame work.



Human activities (Independent variable) that affect wetlands and water resources include industrialization, urbanization, farming, fishing, transport and settlement. These human activities cause different effects (Dependent variable) like pollution, drainage, loss of biodiversity, floods and fluctuation of water levels. If these effects are not checked and become severe, they change the whole ecosystem and also affect the hydrological cycle. However, there are possible measures (intervening variable) that can be used to reduce the effects like public awareness, laws and policies, treatment & management of wastes, fines and charges.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter presents and reviews secondary data that is related to the topic of study.

2.1 Human activities that affect wetlands

Wetlands are among the most highly threatened ecosystems on the planet. They have suffered continuous degradation and loss. According to Wet- lands International, an NGO dedicated to wetlands' preservation in Europe, some 50% of the world's wetlands have disappeared in the last century. For the most part, this loss and degradation is caused by drainage for agriculture, infrastructure developments, forestation and malaria control, blocking and extraction of the water inflow, over-exploitation of groundwater resources, or the building of dams, to mention but a few of the many reasons why wetlands are deteriorating. Additionally, pollution from agricultural and industrial sources can increase the level of nutrients, pesticides or heavy metals, seriously impairing ecological processes (Bird Life International, 2003).

In 1995, the European Environment Agency (EEA) estimated that around 25% of the most important wetlands in Europe were threatened by groundwater overexploitation. In the Mediterranean basin, wetland loss is a particular concern. Spain, for example, has lost more than 60% of all inland freshwater wetlands since 1970 (Kumar *et al.,* 2005). More northerly regions have also suffered, however. In France, 67% of wetlands have disappeared within the last century. Similarly, since the 1950s, 84% of peat soils have been lost in the United Kingdom, and 57% in Germany due to drainage for agriculture activities, forestry and landfilling for urban development. Lithuania has lost 70% of its wetlands in the last 30 years and the open plains of south- western Sweden have lost 67% of their wetlands and ponds to drainage in the last 50 years. Overall, drainage and conversion to farmland alone have reduced the wet- land area in Europe by some 60%. Despite global and national recognition of their importance, Europe's wetlands remain under severe pressure from changing land use and pollution (Fraser &Keddy, 2005).

In Asia, Wetlands have been lost or altered because of the disruption of natural processes by agricultural intensification, urbanization, pollution, water transfer, dam construction, and other forms of intervention in the ecological and hydrological systems. Population growth remains high in the South China Sea (SCS) countries (for example, 2.6% in Cambodia and 1.7% in Vietnam, exceeding the East Asia/Pacific regional average of 1.6%) (Bird Life International, 2003). It is estimated that some 37% of the population in Vietnam, 36% in Cambodia, and 13% in Thailand live below the poverty line. These people in poverty are often those depending on wetland resources for their subsistence livelihoods. Wetland loss and degradation has led to loss of occupation and income (Chan *et al.,* 2001).

Since the late 1970s, the Pearl River Delta has been the fastest developing area in China, acting as an engine for the country's economic development. In the period 1978 to 1990, Guangdong's real gross domestic product (GDP) increased at an average annual rate of 12.3% while its real per capita GDP grew at 10.4%. Due to population increase, urbanization and industrialization, many wetlands in the Pearl River Delta have been destroyed and reclaimed for agriculture, aquaculture, and industrial or residential uses (Chan *et al.,* 2001). Large areas of wetlands have been exploited or converted for farming, or city expansion, resulting in the reduction of wetland area and decline of wetland functions. There were about 400,000 ha of mangrove in Guangdong in the 1950's, however, only 147,000 ha were left in the 1990s. The rate of mangrove loss has been especially high since the 1980s. A total of 7,911.2 ha of mangrove have been destroyed or occupied since 1980, most of which has been converted to aquaculture ponds (7,767.5 ha); reclaimed for construction projects (139.4ha), or converted to salt pans (5.3 ha) (Stuip*et al.,* 2002).

From 1966 to 1996, the total reclaimed area in the entire Pearl River delta is 344 km 2, an average annual rate of 11 km2 yr-1 of reclamation, much greater than that experienced during recent historical times. Major threats which are common to wetlands of all countries bordering the South China Sea include over-exploitation through over-fishing resulting in declining fish productivity; alteration of the hydrological regimes, through draining and wetland reclamation schemes; conversion to other use such as agriculture or urban expansion, aquaculture, agriculture, construction of coastal roads, and physical barriers for coastal protection against erosion. Coastal wetlands continuously receive water, sediment, nutrient and contaminants via inflows from the inland catchment areas. Land-based pollution from industries, tourism, urban areas, agriculture, and aquaculture have impacts on noteworthy fauna, and reduce the value of the benefits and services derived from estuaries, mudflats, and other coastal wetlands (UNEP, 2003).

Wetland areas are experiencing immense pressure from human activities, the most important being drainage for agriculture and settlement, excessive exploitation by local communities and improperly planned development activities. In spite of the noted importance of wetlands to local communities, the human pressure on wetlands is expected to increase as populations grow, unless strategic actions are put in place for the conservation of wetlands (UNEP, 2002). Other threats to African wetlands include changes in wetland water quality due to the effects of industrial effluent and agricultural pesticides, siltation from highland catchment areas, and introduction of alien species of flora and fauna leading to colonization by single species and loss of endemic species diversity. Perhaps one of the biggest single catastrophes has been the introduction of the Nile Perch *Latesniloticus* and a species of tilapia *Oreochromisniloticus* to Lake Victoria which has led to the extinction of a large number of the 200 or so endemic cichlids of the lake; a tragic loss of biodiversity. Similarly, the introduction to the same lake of alien plant species, the Water Hyacinth, *Eichhorniacrassipes* and Water Lettuce *Pistiastratiotes*, threatens the existence of endemic flora (Mitsch&Gosselink, 2009).

In the 1600's, over 220 million acres of wetlands existed in the lower 48 states (Dahl, 2011). Since then, extensive losses have occurred, with many of the original wetlands drained and converted to farmland. Today, less than half of the nation's original wetlands remain. Twenty-two states have lost at least 50 percent of their original wetlands. Indiana, Illinois, Missouri, Kentucky, and Ohio have lost more than 80 percent of their original wetlands and California and Iowa have lost nearly 99 percent (USEPA, 1995). Since the 1970's, the most extensive losses of wetland acreages have occurred in Louisiana, Mississippi, Arkansas, Florida, South Carolina, and North Carolina (Dahl and Johnson, 1991). Between the mid-1970's and the mid-1980's, approximately 4.4 million acres of inland freshwater wetlands (-4%) and 71,000 acres (-1.5%) of coastal wetlands were destroyed (Dahl and Johnson, 1991). Inland forested wetlands were impacted the most during the mid-1970's to the mid-1980's, with a loss of 3.4 million acres (-6.2%), primarily in the Southeast (Dahl, 2011).

Approximately 900,000 acres were converted from forested wetlands to other wetland types. Conversion to agricultural usage of land was responsible for 54 percent of the losses of both freshwater and coastal wetlands; drainage for urban development for 5 percent and "unspecified usage" (planned development) was responsible for 41 percent of the losses. This is in contrast to the mid-1950 to mid-1970, when agricultural drainage of wetlands was responsible for 87 percent of the losses and urban development for 8 percent. Urbanization is a major cause of impairment of wetlands (USEPA, 1994). Urbanization has resulted in direct loss of wetland acreage as well as degradation of wetlands. Degradation is due to changes in water quality, quantity, and flow rates; increases in pollutant inputs; and changes in species composition as a result of introduction of non-native species and disturbance. The major pollutants associated with urbanization are sediment, nutrients, oxygen-demanding substances, road salts, heavy metals, hydrocarbons, bacteria, and viruses (USEPA, 1994). These pollutants may enter wetlands from point sources or from nonpoint sources. Construction activities are a major source of suspended sediments that enter wetlands through urban runoff.

Adverse effects of industry on wetlands can include: reduction of wetland acreage, alteration of wetland hydrology due to industrial water intake and discharge, water temperature increases, point and nonpoint source pollutant inputs, pH changes as a result of discharges, and atmospheric deposition. Saline water discharges, hydrocarbon contamination, and radionuclide accumulation from oil and gas production can significantly degrade coastal wetlands (Klobier& Steven, 2010). Most petroleum hydrocarbon inputs into coastal wetlands are either from coastal oil industry activities, from oil spills at sea, from runoff, or from upstream releases (Kaminski *et al.*, 2006). Oil can alter reproduction, growth, and behavior of wetland organisms, and can result in mortality. Plants suffocate when oil blocks their stomata (Holm & Clausen, 2006). Polynuclear aromatic hydrocarbons (PAHs) are extremely toxic compounds that can enter estuarine wetlands through industrial effluent and atmospheric deposition. PAHs concentrate in sediments and thus contaminate benthic organisms (Kaminski *et al.,* 2006). Fish contaminated with PAHs exhibit external abnormalities, such as fin loss and dermal lesions.

Peat is mined for agricultural and horticultural uses on a relatively small scale in the United States (Mitsch&Gosselink, 2009). Wetlands that are mined for peat are significantly modified, often being transformed into open water habitat (Klobier& Steven, 2010). Peat mining not only removes peat but requires clearing of vegetation, drainage of the wetland, and creation of roads for equipment access to harvest the peat. These activities destroy the portion of the wetland selected for harvest and degrade adjacent areas. Phosphate mining has resulted in the loss of thousands of acres of wetlands in central Florida (Mitsch&Gosselink, 2009). Other types of mining operations can also degrade wetlands through hydrologic alterations, high metal concentrations, and/or decreased pH.

2.2 Effects of human activities on wetlands

Although the drainage of wet- lands has been common practice in Europe for centuries, the extent of this human intervention has increased significantly in the past century, and especially in the last 50 years. Some two- thirds of the European wetlands that existed 100 years ago have been lost, leading to a substantial decrease in the number, size and quality of the natural habitats of large bogs, marshes, and small or shallow lakes. This has dramatically altered both the visual landscape and the environmental functions of these habitats. Even with increased awareness and certain moves towards wetlands' conservation, this trend continues, albeit more slowly (Fraser &Keddy, 2005).

Loss of coastal wetlands and their ecological functions of storm and flood protection, and coastal erosion control leads to severe damage and loss of life and property among coastal communities. For example, between May and September 1994 Southeast Asia was devastated by 5 months of storms and floods that destroyed 220,000 houses in the Mekong Delta of Vietnam and caused major losses in the rice crop (Chan *et al.,* 2001). Tropical storms battered and drenched southern China, Vietnam and Thailand during the period of June-November 1995. In 2000, the Mekong River delta experienced the longest-lasting and most severe flooding to affect the area in 40 years. Floodwaters exceeded Alarm Level III (very dangerous flood conditions) and flooding was reported in Thailand, Cambodia and Laos (IRI, 2000). The floods affected almost 9 million people and killed 800. Damage was estimated at more than US$ 455 million. Without wetlands preventing such losses, investment in coastal and flood plain protection are required. Wetland degradation and loss have resulted in the disappearance of coastal vegetation, reducing the effectiveness of coastal protection from typhoon winds and flood. In September 2003, Typhoon Dujuan, the strongest storm to hit the Pearl River delta since 1979, killed 38 people, injured more than 1,000 and up-rooted 30% of all trees in the area. The direct economic losses were estimated at US$ 242 million and the severe impacts of this typhoon can be partly attributed to the loss of natural coastal protection: coastal wetlands. In the context of climate variability and change, the projected sea level rise and increases in storm surges due to wetland degradation are likely to affect coastal wetlands significantly. Such changes may cause substantial ecological and economic losses (Talaue, 2000).

The case study on Djoudj National Bird Park, for example, records the construction of dikes and dams on the upper parts of the Senegal River for the development of rice cultivation. This has altered the freshwater regime, threatening the survival of some plant species and encouraging the spread of others - essentially altering the characteristics of the ecosystem. Equally, the damming of the Tana and Athi rivers in Kenya has blocked upstream movement of migratory fish species, while poor water management schemes in the north of Cameroon have reduced natural flooding in Waza National Park, thus contributing to the decrease in the populations of two species of antelope, the Korrigum *Damaliscuslunatuskorrigum* and Buffon's *KobKobuskobkob* (Mitsch&Gosselink, 2009).

South Africa's landscapes have changed dramatically over the past few centuries, largely through human settlement and associated activities. Short-sighted development, inappropriate land use practices and poor land management have significantly impacted on the ecosystems that form the core of the nation's natural capital. Yet South Africa relies on these very ecosystems to provide the life-support services that sustain its people and rich biodiversity. It is thus highly probable that the extent of wetland loss in South Africa accords well with the global estimate of 50% loss cited by the Ramsar Convention on Wetlands. Worldwide, wetlands have historically been perceived as valueless wastelands, having little productive use to society and no direct economic value to landowners (IRI, 2000). They needed to be "reclaimed" to enhance the benefits that people could derive from them. In South Africa, this view has largely been responsible for the extensive drainage and conversion of wetlands for agriculture, dams, infrastructure and urban development (John Dini, 2009).

In Louisiana, coastal areas are subsiding as a result of the redirection of sediment by the Mississippi River levees, subsurface withdrawals of water, oil, gas, sulfur, and salt, from under wetlands, channelization of wetlands, and drainage of wetlands for development (Caffey&Schexnayder, 2003). As the coast subsides, sea levels rise, essentially, to cover the land. The loss of $300 million worth of coastal real estate in the next 50 years is possible if subsidence continues. The cost of the loss of wetland habitat as the sea levels rise to cover the land has not been determined. Land subsidence also allows saltwater intrusion into freshwater wetlands and causes shifts in the plant and animal community (Nicholas, 2009). Saltwater intrusion and the subsequent modification of wetlands habitat threaten the billion dollar fishery industry as well as the multi-million dollar trapping business (Caffey&Schexnayder, 2003).

Habitat fragmentation, as wetlands are drained or hydrologically altered, may result in changes in species composition as wetlands species are replaced by upland species; loss of large, wide-ranging species; loss of genetic integrity when isolated habitats are too small to support viable populations; reduced populations of interior species that can only reproduce in large tracts; and increased numbers of competitor, predator, and parasite species tolerant of disturbed environments (Nicholas, 2009). Water diversion structures, such as canals (channels), ditches, and levees have been used to modify wetlands to achieve flood control, drainage, mosquito control, irrigation, timber harvest, navigation, transportation, and industrial activity (Mitsch&Gosselink, 2009). Canals and channelization change the hydrology of wetlands and increase the speed with which water moves into and through wetlands. As a result, patterns of sedimentation are altered and wetland functions and values that depend on the normal slow flow of water through a wetland can be affected. High sediment loads entering wetlands through channels, irrigation ditches and drainage ditches can smother aquatic vegetation, shellfish beds and tidal flats, fill in riffles and pools, and contribute to increased turbidity (USEPA, 1994).

Channelization and channel modification alter in stream water temperature and diminish habitat suitable for fish and wildlife (USEPA, 1994). Normal sheet flow through wetlands is inhibited by the spoil banks that line a canal and by road embankments. Spoil banks and embankments also increase water stagnation. Channels often connect low-salinity areas to high-salinity areas, resulting in saltwater intrusion upstream, and causing species change and mortality of salt-intolerant vegetation.

Impoundment of natural wetlands for storm water management or wildlife and habitat management may exploit one function of wetlands at the expense of others Mitsch&Gosselink, 2009). Impoundment alters the natural wetlands' hydrology and decreases water circulation. Decreased water circulation causes increased water temperature, lower dissolved oxygen levels, and changes in salinity and pH; prevents nutrient outflow; and increases sedimentation (USEPA, 1995). Sedimentation reduces the water storage capacity, smothers vegetation, reduces light penetration, reduces oxygen content and affects the entire ecosystem richness, diversity, and productivity. Toxic substances, adhering to sediments, may accumulate in impoundments as a result of decreased water circulation and bioaccumulation of contaminants by wetland biota may occur (USEPA, 1995).

Impoundment of coastal wetlands reduces the exchange of tidal water in salt marshes and can impede the movement of fish that use the marsh for a part of their life cycle. Impoundments are often invaded by non-native plant species such as common reed (*Phragmites*) and purple loosestrife (*Lytherium*) which out-competes the native species and change the wetland community structure. Irrigation ditching can increase contamination of wetlands receiving irrigation drainage water, particularly where soil is alkaline or contains selenium or other heavy metals (Klobier& Steven, 2010). Untreated runoff containing extremely high concentrations of selenium led to mortality and deformities in bird, amphibian, and fish embryos and the disappearance of species from wetlands in California (USEPA, 1995). Agricultural pesticides entering wetlands in runoff, as well as through atmospheric deposition, might bio-accumulate in fish and other aquatic organisms (Kaminski *et al.*, 2006).

Nitrous oxides, sulfurous oxides, heavy metals, volatilized pesticides, hydrocarbons, radionuclides, and other organics and inorganics are released into the atmosphere by industrial and agricultural activities, and from vehicles. These compounds can enter wetlands through wet and dry atmospheric deposition and can adversely affect aquatic organisms and the terrestrial organisms that feed on them (Mitsch&Gosselink, 2009). Urban and industrial storm water, sludge, and wastewater treatment plant effluent, rich in nitrogen and phosphorus, can lead to algal blooms in estuaries. Algal blooms deplete dissolved oxygen, leading to mortality of benthic organisms. Some algae are toxic to aquatic life (Kaminski *et al.*, 2006). Excess algae can shade underwater sea grasses (part of the coastal wetland ecosystem), preventing photosynthesis and resulting in sea grass death (Holm & Clausen, 2006). Because sea grass meadows reduce turbidity by stabilizing sediments and provide critical food, refuge, and habitat for a variety of organisms, including many commercially harvested fish, the death of these plants profoundly impairs the estuarine ecosystem (Kaminski *et al.*, 2006).

Roads and bridges are frequently constructed across wetlands since wetlands have low land value. It is often considered to be more cost effective to build roads or bridges across wetlands than around them (Holm & Clausen, 2006). Roads can impound a wetland, even if culverts are used. Such inadvertent impoundment and hydrologic alteration can change the functions of the wetland. Road and bridge construction activities can increase sediment loading to wetlands (Mitsch&Gosselink, 2009). Roads can also disrupt habitat continuity, driving out more sensitive, interior species, and providing habitat for hardier opportunistic edge and non-native species. Roads can impede movement of certain species or result in increased mortality for animals crossing them. Borrow pits (used to provide fill for road construction) that are adjacent to wetlands can degrade water quality through sedimentation and increase turbidity in the wetland (Klobier& Steven, 2010).

Grazing livestock can degrade wetlands that they use as a food and water source. Urea and manure can result in high nutrient inputs. Cattle traffic may cause dens and tunnels to collapse. Overgrazing of riparian areas by livestock reduces streamside vegetation, preventing runoff filtration, increasing stream temperatures, and eliminating food and cover for fish and wildlife. As vegetation is reduced, stream banks can be destroyed by sloughing and erosion. Stream bank destabilization and erosion then cause downstream sedimentation (Kaminski *et al.*, 2006). Sedimentation reduces stream and lake capacity, resulting in decreased water supply, irrigation water, flood control, hydropower production, water quality, and impairment of aquatic life and wetland habitat (USEPA, 1994).

Historically, agriculture has been the major factor in freshwater and estuarine wetland loss and degradation. Although the passage of the Food Security Act of 1985 "Swamp buster" provision prevented the conversion of wetlands to agricultural production, certain exempted activities performed in wetlands can degrade wetlands: harvesting food, fiber, or forest products, construction and maintenance of irrigation ditches, construction and maintenance of farm or forest roads, maintenance of dams, dikes, and levees, direct and aerial application of damaging pesticides (herbicides, fungicides, insecticides, fumigants), and ground water withdrawals. These activities can alter a wetland's hydrology, water quality, and species composition. Excessive amounts of fertilizers and animal waste reaching wetlands in runoff from agricultural operations, including confined animal facilities, can cause eutrophication. Pesticides and fertilizers used during silvicultural operations can enter wetlands through runoff as well as through deposition from aerial application. Fertilizers may contribute to eutrophication of wetlands (Shepard, 1994).

2.3 Measures taken to reduce the effects

In the United States of America, wetland and water resources' protection has in one way been achieved through laws and policies. Section 404 is the backbone of wetland protection in the United States today. Yet, the vague language of the regulation, multiple exemptions, loopholes, and activities not covered allow many wetlands to be legally degraded or destroyed. For example, Section 404 has no control over ground water pumping that can completely de-water a wetland (USEPA, 1994). As a result of the above caveats, by most estimates, only about 20 percent of the activities that destroy wetlands are regulated under the Section 404 program (Isola*et al.,* 2002). It should be noted that a large part of the remaining activities involve agriculture, which has been a major cause of past wetland losses. As discussed below, the 1985 and 1990 Farm Bills have attempted to fill this gap in coverage (Isola*et al.,* 2002).

Section 401, the state water quality certification process, gives states authority to grant, deny, or condition issuance of federal permits or licenses that may result in a discharge to waters of the United States, including the discharge of dredged or fill material. Through the 401 certification process, states can prevent noncompliance with water quality standards through permit denials (such as Section 404 individual permits discussed above) or conditions of permit issuance (for example, mitigation requirements). States are encouraged by EPA to use 401 certification as a means of protecting wetlands and of offsetting unavoidable impacts by obtaining mitigation proposals before granting 401 certification. EPA offers guidance to the states on this process (USEPA, 1995), and some states have implemented it, resulting in essentially de facto Section 404 dredge and fill regulation at the state level. Of course, this approach to wetland protection is only as effective as the associated 404 protections.

As mentioned above, agriculture has historically played a significant role in the alteration and loss of wetlands in the United States, and much agricultural activity is exempted from the Section 404 program. To address this gap, the Food Security Act (Farm Bill) of 1985 included two major wetlands provisions, "Swamp buster" and the Conservation Reserve Program (CRP). The Swamp buster provision of the 1985 Farm Bill, and amendments in the Food, Agriculture, Conservation, and Trade Act (Farm Bill) of 1990, were designed to discourage the further conversion of wetlands for agricultural commodity production and can be categorized as disincentives. The Swamp buster provision requires the withholding of all USDA program benefits from any person who 1) plants an agricultural commodity on a wetland that was converted after December 23, 1985, or 2) converts a wetland for agricultural commodity production after November 28, 1990, even if the crop is not planted (USEPA, 1994).

In 1986, the United States and Canada continued collaboration initiated through the Ramsar Convention by developing the North American Waterfowl Management Plan. The goal of the Plan is to conserve and restore, in both countries, 2.4 million hectares of wetland habitat used by waterfowl. The support and financial involvement of private conservation organizations, such as Ducks Unlimited, has been critical to the success of the Plan. Public and private partnerships in both countries will be required for successful implementation of the Plan, as there are no federal funds provided by either the United States or Canada (Mitsch&Gosselink, 2009).

The threat to African wetlands has global effects on the world's biodiversity. The future of African wetlands lies in a stronger political will to protect them, based on sound wetland policies and encouragement for community participation in their management (Ramsar Convention Bureau, 2000). Although the goal for protected wetlands should continue to be conservation of endangered and fragile sites, greater efforts should be focused on wetlands outside protected areas, and new management strategies formulated which incorporate the stakeholders. The Government of Uganda has recently launched such a policy for the conservation of its wetland resources. This is the first of its kind in Africa to have been formulated in accordance with the recommendation from the Ramsar Convention. It encompasses wetlands in protected and non-protected areas and offers the best example in Africa of a strong political will to conserve wetlands and their biodiversity. It is important that African countries put such policies in place, and other management strategies such as Integrated Coastal Zone Planning, an important measure for safeguarding coastal wetlands. Such a plan is being carried out in Guinea Bissau at the present time with the assistance of the World Conservation Union (IUCN) (Mitsch&Gosselink, 2009).

In South Africa, typical activities undertaken within the projects include: the building of concrete, earth or gabion structures to arrest erosion, trap sediment and re-saturate drained wetland areas; using structures and landscaping to reinstate diminished flood mitigation and water quality enhancement functions; plugging of artificial drainage channels; addressing offsite causes of degradation, such as inappropriate agricultural practices; re-vegetation and bio-engineering; eradicating invasive alien plants; raising awareness of wetlands among workers, landowners and the public; providing technical skills, and developing management plans for the rehabilitated wetlands (John Dini, 2009).

CHAPTER THREE

MATERIALS & METHODS

3.0 Introduction

This chapter elaborates the materials and methods the researcher used to collect data, research design, sampling methods, data sources among others. It also gives the description of the study area in terms of location, climate, economic activities, and population, among others.

3.1. Description of the study area

Nakivubo wetland is located at 00 018 1N; 32 038 1E and at an altitude of 1135m above sea level. The wetland separates Kampala city from the Inner Murchison Bay of Lake Victoria. The wetland is dominated by Cyperus papyrus and Miscanthidium violaceum and has been receiving wastewater from the city of Kampala Nakivubo wetland is the largest. It covers approximately 5.29 km2, and has a total catchment extending over 40 km2. Lying to the south- east of Kampala District, Nakivubo forms a permanent swamp and is fed by the Nakivubo Rivers and its tributaries the Katunga, Kitante, Lugogo and Nakulabye Rivers. The wetland runs from the central industrial district of Kampala, entering Lake Victoria at Murchison Bay. The activities that take place in Nakivubo wetland include farming, settlement and industrial development. Nakivubo wetland is bisected by a railway line running through Central Kampala to Port Bell on Lake Victoria.

3.2 Research Design.

The study used both qualitative and quantitative research designs. Qualitative design was used through asking questions and getting the feedback which were recorded and presented in a narrative form. Quantitative design was used to reveal the numerical form of data such as statistics, percentages and so forth. It was used to quantify the size, distribution and association of the variables.

3.3 Target Population

The target population was the residents in and near Nakivubo wetland. These participants were selected depending on how long they have been in that area and their activities, which helped me to determine the changes that have occurred in the wetland.

3.4 Sampling Design

3.4.1 Sample Size

The total sample size of the study was 52 respondents, comprising of 45 local people both male and female, 2 local leaders, 2 elders, 1 environment officer and 2 people from any of the industries around Nakivubo wetland irrespective of the position.

45 Local people + 2 Local leaders + 2 Elders + 1 Environment officer + 2 Representatives from any industry = 52 respondents

3.4.2 Sampling Method

I used simple random sampling that gave each member an equal chance to be chosen in the sample group.

Judgmental sampling which is a non-random sampling method was used to select specific people like local leaders, elders, an environment specialist and 2 people from any of the industries around.

3.4.3 Sampling procedure

On reaching to the field of study, the researcher used simple random sampling by requesting the local people who were interested in giving relevant data to gather in one place. Their number became higher than required, and I rolled papers equivalent to their number but some of them possessed numbers from 1 to 45 while others did not. Those who picked papers from number 1 to 45 formed the group that represented the rest of the community members. For the case of elders, local leaders, environment officer and people from the industries, I judged following their availability and readiness to give information.

3.5 Sources of Data

The source of data of the study was both primary and secondary.

3.5.1 Primary data

This involved collection of data from respondents who were living in the designated area using research instruments such as in-depth interviews, focus group discussion, and direct observations as well as use of questionnaires.

3.5.2 Secondary data

Secondary data was gathered from the available documentation concerning impacts of human activities on wetlands and water resources. The sources of information included books, journals, and relevant documentations from the Non-governmental organizations as well as officials who work in environment related issues.

3.6 Data collection methods

In order to address the objectives of the research, the researcher used the following instruments in gathering and collecting data.

3.6.1 Questionnaires

Questionnaires were issued to the selected respondents, made up of open and closed ended questions. The questionnaires were self-administered amongst the respondents especially those who knew how to read and write. Then particularly to the illiterates, the researcher took initiative to administer the questionnaires and recording the responses.

3.6.2 Interview guide

The researcher was able to conduct personal interviews with the key informants. The key informants involved a local leader, environment officer, an elder of the area and two persons from any of the industries around.

3.6.3 Observation checklist

This method involved close use of the eye sense to observe the phenomena. Settlements, industries, roads among other activities and their effects were observed.

3.6.4 Focus Group Discussions

This instrument was used in data collection in that, the researcher put respondents in small groups of between 4 to 8 people and asked them to give responses to the set questions in the interview guide. The responses were then be recorded and later compiled to make it relevant to the study.

3.7 Ethical Consideration

Before commencing the research, an introductory letter from the University was acquired and the purpose of the study explained to the authorities to avoid inconveniences and misunderstandings about the purpose.

3.8 Validity and Reliability

The interview guide and questionnaires were cross examined for approval by the research expert, to ensure the appropriateness and consistency of information generated.

3.9 Data Analysis and Presentation

Descriptive analysis was used to analyze the data collected from the field by relating them to the study objectives. Tables were used to present the field results.

CHAPTER FOUR

PRESENTATION OF FINDINGS AND DISCUSSION

4.0 Introduction

This chapter comprises the research findings which includes among others; the demographic characteristics of the respondents, human activities done on Nakivubo wetland, their impacts and what has been done to reduce the impacts.

4.1 Demographic characteristics of respondents

Table 1: Sex of respondents

SEX	FREQUENCY	PERCENTAGE
Male	22	42
Female	30	58
Total	**52**	**100**

Source; primary source

Among the respondents involved in this research, female (58%) were higher than males (42%), an indication that there is high reproduction which is one of the reasons why there is population increase of people living in Nakivubo wetland.

Table 2: Age of the respondents

AGE	FREQUENCY	PERCENTAGE
Below 15 years	8	15
16-35 years	28	54
36-50 years	10	19
50 above	6	12
Total	**52**	**100**

Source; primary source

This research found out that 54% of the respondents were aged 16-35 years which is the highest, followed by 19% aged 36-50 years. The least percentage of the population is represented by those aged below 15 years (15%) and those above 50 years (12%). This elaborates that there is a higher population of individuals who are strong and able to utilize the wetland for their development.

Table 3: Marital status of respondents

MARITAL STATUS	FREQUENCY	PERCENTAGE
Single	25	48
Married	20	39
Widowed	4	8
Divorced	3	6
Total	**52**	**100**

Source; primary source

Table 3 above illustrates that most of the population staying in and around Nakivubo wetland were single (48%), an indication that the youth who still have enough energy and many things to achieve are the highest. This puts the wetland at a bigger risk of more degradation not only currently but also in future when the youth have given married and produced more people.

Table 4: Occupation of respondents

OCCUPATION	FREQUENCY	PERCENTAGE
Business	15	29
Student	6	12
Farmer	8	15
Official	1	2
Professional	3	6
Casual	19	37
Total	**52**	**100**

Source; primary source

Most of the people living in Nakivubo wetland are casual workers (37%) and the least number of respondents were officers (2%) and professional workers like teachers and nurses (6%) indicating that most people have an easy interaction with the environment they live in

(Nakivubowetland) since they are available at any time the work they do is determined by where they live; which is one of the contributions towards wetland degradation.

Table 5: Population per house hold

No. OF PEOPLE	FREQUENCY	PERCENTAGE
< 6	18	35
6-10	25	48
>10	9	17
Total	**52**	**100**

Source; primary source

According to the study, the most households are comprised of 6-10 (48%) members that clearly show that there is less or no use of family planning in these families that has resulted to increase in population of people living in Nakivubo in the long run and this affects wetland management.

4.2 Human activities done in Nakivubo wetland

Table 6: Human activities done in Nakivubo wetland

ACTIVITIES	FREQUENCY	PERCENTAGE
Mining and brick laying	5	10
Fishing	3	6
Crop farming	4	8
Animal grazing	2	4
Settlement	8	15
Waste dumping	10	19
Collection of swamp vegetation	2	4
Transport	3	6

Urbanization	5	10
Industrialization	10	19
Total	**52**	**100**

Source; primary source

According to table 6 above, industrialization (19%) and waste dumping (19%) are the most activities done in Nakivubo wetland. The existence of various industries like Coca cola, Rwenzori and steel industries in and near Nakivubo wetland has led to increased degradation and pollution of the resource. Nakivubo wetland would be a very important resource in the natural treatment of water before it enters Lake Victoria but it has been not effective because of its degradation by human activities. The wetland receives water from many parts of Kampala including the industrial area and Bugolobi sewage treatment plant though Nakivubo channel. This water would be expected to enter Lake Victoria when it is safe for the aquatic organisms but this has been impossible because of Nakivubo wetland degradation.

Settlement (15%), mining and brick laying (10%) and urbanization (10%) were also evident in Nakivubo wetland. Many people have constructed in the area and near it while urbanization that is a result of population increase is also expanding. These have led to more production of solid wastes, pollution and drainage of the wet land. Bricklaying in this area has also started increasing since there is enough clay that produces very good and marketable bricks, at the same time mining of sand for construction has also affected the wetland.

Animal farming (4%) and collection of wetland vegetation like papyrus (4%) are the least activities that take place in Nakivubo wetland but their effects are also evident. Animal rearing affects the vegetation and also increases water pollution as animals drop their wastes. Fishing (6%) is not so much exercised because there is scarcity of fish, only the common ones are mudfish but they have also reduced. This is attributed to the fact that Nakivubo wetland is much polluted and in some parts there is eutrophication which distorts the conditions of the wetland for aquatic animals to replenish. The above activities done in Nakivubo wetland are related to Bird Life International, (2003) which reported that 50% of the world's wetlands have disappeared in the last century. For the most part, this loss and degradation is caused by drainage for agriculture, infrastructure developments, forestation and malaria control, blocking and extraction of the water inflow, over-exploitation of groundwater resources, or the building of dams, to mention but a few of the many reasons why wetlands are deteriorating. Additionally, pollution from agricultural and industrial sources can increase the level of nutrients, pesticides or heavy metals, seriously impairing ecological processes.

4.3 Effects of human activities on wetlands

Table 7: Effects of human activities on wetlands

EFFECT	FREQUENCY	PERCENTAGE
Drainage of the wetland	7	13
Death of species	9	17
Migration of species	4	8
Soil fills the wetland after raining	3	6
Vegetation loss	6	12
Floods	5	10
Increased temperatures	4	8
Reduced rainfall	2	4
Water pollution	12	23
Total	**52**	**100**

Source; primary source

Table 7 above illustrates water pollution (23%) as the most effect of human activities on Nakivubo wetland. People reported that pollution results from the industries that discharge their wastes into the wetland and the contaminated water that comes from other parts of Kampala through Nakivublo channel. This is related to USEPA, (1995) &Kaminski *et al.*, (2006) who said that untreated runoff containing extremely high concentrations of selenium led to mortality and deformities in bird, amphibian, and fish embryos and the disappearance of species from wetlands in California and agricultural pesticides entering wetlands in runoff, as well as through atmospheric deposition, might bio-accumulate in fish and other aquatic organisms. People were confident that their settlement in and near the wetland does not pollute the water because they are not too many and if it was for them alone, the wetland would be able to assimilate their wastes easily.

They even reported that death of very many species (17%) has resulted from water pollution by industries not their settlement in the area. They reported that before industries were many in the area and the rest of Kampala, water looked clean and there were more aquatic animals like worms, mudfish, frogs and more others including dense wetland vegetation. However, they also accepted that a lot has been done towards wetland degradation especially through draining it. Wetland drainage (13%) was taken as an effect more due to human settlement, where they needed to clear some vegetation and drain water for the construction of their houses. In so doing, vegetation loss (12%) became much that it was not and is not lost only to preparing land for settlements but also for crop growing especially coco yams and selling them to people outside that locality who need to use them for mulching.

People who lay bricks also use the same vegetation for covering their bricks to protect them from rainfall. It was reported that the time given to this vegetation to replenish is always less than 18 months and they cut again. This exposes the wetland and makes it fail to perform it natural activities that results into floods (10%), migration of species (8%), increased temperatures (8%), siltation of the wetland (6%) and reduced rainfall (4%). The occurance of floods is related to Chan *et al.,* (2001) who wrote that loss of coastal wetlands and their ecological functions of storm and flood protection, and coastal erosion control lead to severe damage and loss of life and property among coastal communities. For example, between May and September 1994 Southeast Asia was devastated by 5 months of storms and floods that destroyed 220,000 houses in the Mekong Delta of Vietnam and caused major losses in the rice crop.

4.4 Measures taken to reduce the effects

Table 8: Measures taken to reduce the effects

MEASURE	FREQUENCY	PERCENTAGE
Laws and policies related to wetlands	12	23
Public awareness	8	15
Relocation of people	3	5
Treatment of wastes before dumping	6	12
Water treatment	16	31
Management committees	7	14
Total	**52**	**100**

Source; primary source

Respondents informed the researcher that there are some measures taken to reduce the impact of human activities on the wetland. Water treatment (31%) was the highest measure reported by people in a view that the government constructed Ggaba water treatment plant and Bugolobi sewage treatment plant to reduce on the effects of waste generation on both Nakivubo wetland and Lake Victoria. However, I asked them whether there is any treatment mechanism located in the area to treat wastes that come from their locality and industries, but they denied it and reported that there are some laws and policies (23%) they are aware of, which were given both to them and those industries to prevent pollution.

Laws and policies in wetland management are related to (USEPA, 1994) which stated that in the United States of America, wetland and water resources' protection has in one way been achieved through laws and policies. Section 404 is the backbone of wetland protection in the United States today. They reported that there are some small management committees (14%) chaired by the LC leaders to help in implementation of these policies among the local people. For the case of industries, they reported that some have been requested to treat their wastes before discharge (12%) while others pay for the pollution they cause.

Besides water treatment and laws, respondents also reported that public awareness (15%) has been so much influential in reducing effects of human activities on Nakivubo wetland. They said that they are aware of the causes, effects and management strategies like polices. They also said that it is through the committees, media and face to face interaction that the government and other organizations disseminate the information to them. Re allocation of people was the least measure reported by the respondents of which most of them were even saying is the worst measure they can hear of.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.0 Introduction

Thischapter is comprised of general conclusions on the findings of the study and the recommendations.

5.1 CONCLUSIONS

Industrialization (19%) and waste dumping (19%) were pointed out as the most activities that take place in Nakivubo wetland and are considered to be the root causes of all degradation in this ecosystem whereas animal grazing (4%) and collection of swamp vegetation (4%) were the least activities practiced but whose effects are also direct to the wetland.

Water pollution (23%) was the most effect of human activities in Nakivubo wetland as a result of industrialization and waste dumping. This has resulted to secondary effects like death of species (17%) and drainage of the wetland (13%). According to the respondents, reduced rain fall (4%) is the least activity that they have evidenced at the moment.

According to table 8 in chapter four, water treatment (31%) showed up as the most measure available to help in reducing the effects of human activities on Nakivubo wetland which was said to be implemented by the government of Uganda at Ggaba water treatment plant and Bugolobi sewage treatment plant. Laws and policies (23%) alongside other measures was also a very influential measure in managing the wetland. Re allocation of people (5%) was the least measure practiced in the area and the respondents used a defensive language that it is not even the root cause of all evil; saying it is industrialization.

5.2 RECOMMENDATIONS

I recommend that the government of Uganda through NEMA and the police should work together and realize the need for Nakivubo wetland especially the ecological and hydrological functions and strictly implement the available laws and policies to protect it. Wetlands and all other natural resources in Uganda have continually been degraded not because there are no conservation measures but because they are poorly implemented. Laws and policies should form the basis for implementation of all other measures like re-allocation of people, treatment of wastes before dumping, public awareness among others. Therefore, industrialization and waste dumping, settlement among other activities in Nakivubo wetland should be abolished using laws and policies.

With the current effects of human activities on Nakivubo wetland like water pollution, death of species and drainage, I recommend rehabilitation of the wetland by using the laws and policies as mentioned above, alongside intensive sensitization of people about the ecological, hydrological and social values of Nakivubo wetland.Drainage of the wetland should be stopped by relocatingpeople already in the wetland to other areas and completely stopping more immigration. Farming, brick laying and road construction should be regulated because they lead to wetland drainage.

Water treatment and laws and policies being the most approaches being used to address the effects of human activities on Nakivubo wetland, I recommend the addition of more efforts and even uplifting of other methods being used. More to that, there is need to come up with alternative ways of dumping wastes not necessarily in the wetland especially for solid wastes (both biodegradable and non-biodegradable wastes) which can be disposed to landfills. Death and migration of species can be sorted with time as conditions in the wetland stabilize.Thus, a combination of these approaches is essential for the effective short- and long-term protection of Nakivubo wetland and all other natural resources in Uganda.

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APPENDIX I

QUESTIONNAIRE

I am **BulonzaNyakabasa**; a student of Kampala International University (main campus), School of Engineering and Applied Sciences conducting a research entitled **"Impacts of human activities on wetland resources at Nakivubo wetland Kampala".** Please answer all the questions below.

Questionnaire number...

Date...

Tick the right options

Section A: Socio-Demographic data

1. Sex
   a. Male ☐
   b. Female ☐
2. Marital Status
   a. Single ☐
   b. Married ☐
   c. Any other ....

3. Age

   a. Below 15 years ☐

   b. 16-35 years ☐

   c. 36-50 years ☐

   d. 50 above ☐

4. Occupation

a. Business

b. Official

c. Student

d. Others (specify)..................................

6. Number of persons per house hold

a. < 6

b. 6-10

c. 11>

Section B: Human activities that take place in Nakivubo wetland

7. Which human activities take place in and around Nakivubo wetland?

Activities	**Tick your choice**								
Mining									
Fishing									
Crop farming									
Animal grazing									
Settlement									
Waste dumping									
Collection of swamp vegetation									
Transport									
Urbanization									
Industrialization									

8. Among the above activities which one do you participate in or near the wetland?

a. Farming
b. Settlement ☐
c. Fishing ☐
d. Mining ☐
e. Others specify...

Section C: Effects of human activities on the wetland

9. What are the effects of the above activities you have ticked on the wetland?

Effects	**Tick your choice**								
Drainage of the wetland									
Death of species									
Migration of species									
Soil fills the wetland after raining									
Vegetation loss									
Floods									
Increased temperatures									
Reduced rainfall									
Water pollution									

Section D: Possible measures that can be taken to reduce the impact

10. What are the possible measures that can be taken?

Measures	Tick your choice								
Laws and policies									
Public awareness									
Re allocation of people									
Treatment of wastes before dumping									
Water treatment									
Management committees									

11. Which people or bodies are responsible for implementation of the above measures you have ticked?

a. NEMA ☐
b. NGO's ☐
c. Local people ☐
d. KCCA ☐
e. Others specify...

12. What recommendations do you give to improve on the management of Nakivubo wetland?..
....
....

APPENDIX II

INTERVIEW GUIDE

a. What human activities take place in Nakivubo wetland?

b. Among the activities that take place, which one (s) are you involved?

c. Are there any companies or investors that do their activities in this wetland?

d. What could be the effects of human activities on Nakivubo wetland?

e. Do you think those effects can be stopped or reduced?

f. How can they be stopped or reduced?

g. Is there any organization or body trying to take control?

h. Name that organization or body........

i. Have you personally participated in any of the conservation measures?

j. What recommendation do you give to improve on the control measures?

APPENDIX III

OBSERVATION CHECKLIST

Activity	Observed (tick) or not observed (x)								
Industries									
Crop growing									
Animal rearing									
Vegetation clearing									
Mining clay and sand									
Fishing									
Construction of roads									
Settlements									
Disposing of wastes									
Drainage									