INFLUENCE OF HUMAN ACTIVITIES ON WETLANDS ON THE PHYSICAL ENVIRONMENT IN NAIROBI COUNTY, KENYA: A CASE OF WESTLANDS SUB-COUNTY

BY

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DECLARATION

This research project report is my original work and has not been presented for an award in a university or any other institution of learning.

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Declaration by the Supervisor

This research project report has been submitted for presentation with my approval as the University Supervisor.

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DEDICATION

This research is dedicated to my parents, Prof.Ariga, my mum Jane and my brothers, Elvis, Edmund and Harold; for their love, support, encouragement and patience during the entire period of my study.

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ABBREVIATIONS AND ACROMNYS

ANOVA	Analysis of Variance
CDM	Clean Development Mechanism
DNA	Designated National Authority
EIA	Environmental Impact Assessment
EMCA	Environmental Management and Coordination Act
FAO	Food and Agriculture Organization
GoK	Government of Kenya
IRB	Institutional Review Board
IWRM	Integrated Water Resource Management
KALRO	Kenya Agricultural and Livestock Research Organization
KNBS	Kenya National Bureau of Statistics
KNHPC	Kenya National Housing and Population Census
KRB	Kenya Roads Board
MEA	Millennium Environment Assessment
NEMA	National Environment Management Authority
OECD	Organisation for Economic Co-operation and Development
SPSS	Statistical Package for Social Sciences
UNCBD	United Nations Convection on Biological Diversity

UNEP	United Nations Environment Programme
UNFCC	United Nations Framework Convention on Climate Change
UoN	University of Nairobi
WEMASK	Wetland Monitoring and Assessment Strategy
WRMA	Water Resources Management Authority

ABSTRACT

Water is becoming increasingly important within Nairobi area and specifically in Westlands sub-county, which was my main area of research. This is mainly due to the increasing population caused by urban influx, industrialization, expansion and even agriculture and farming in the area. Westlands area is a well formed water catchment zone. The purpose of this study was to assess the influence of human activities on wetlands on the physical environment; while also looking at ways in which wetland utilization can be achieved sustainably. Environmental degradation has had devastating effects on natural resources. One major effect is wetland loss and degradation. This sorry state has to a great extent been attributed to human behaviour (Mwakaje, 2009). Such anthropogenic factors include human activities on wetlands. Westlands sub-county in Nairobi County has experienced a fair share of human encroachment on its wetland resources. The study employed purposive sampling technique. The target population was 5 County government official representatives, 3 Environmental Officers from NEMA and 2 physical planners from Ministry of Devolution and Planning selected through purposive sampling. The sample size was 160 based on Cochrane (2006), selected through the systematic random sampling technique whereby each member of the subset had an equal probability of being chosen. The sample to be used was therefore 28 residents from Kitisuru, 35 from Parklands/ Highridge, 24 from Karura, 40 from Kangemi and 33 from Mountain View constituencies. This formed the basis of this research study. The main instrument used in the study was questionnaires, whose reliability testing was done using the split-half method. The method of data collection was done through administering of questionnaires to respondents, with both closed and open ended questions, which were then collected back and collated for analysis. The data analysis technique used in this study was descriptive statistics, where the data was collated, coded and entered into SPSS system software. Quantitative data was then presented using percentages and frequency distribution tables, while the qualitative data was presented in verbatim statements. It was eminent from the study that human activities on wetlands influence the physical environment; causing detrimental effects such as soil erosion, loss of land cover, water pollution and air pollution; these activities being agricultural activities, construction of public infrastructure and construction of residential structure. Nairobi County thus requires a method in which the problem of wetland degradation in the area is solved, and also long-term measures to ensure satisfaction of human needs for both the current and future generations. This could be done through harnessing the national policies to involve the community in education on the importance of wetland conservation; and also helping in cleaning the wetlands and planting trees upstream to conserve the riparian reserve. Therefore, this research study was not only vital in solving wetland degradation, but also aiding in coming up with solutions to environmental issues associated with wetland degradation. This will in turn enable the community to understand how their encroachment to wetlands has and continues to result in to damaging effects to themselves and to the biological diversity.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Wetlands are among the most naturally beneficial biological ecosystems because they harbor a wide species variety (Mwakaje, 2009). They are among ecosystems that are most productive due to their attributes. Wetlands are essential to the well-being of humans in the context of socio-economic roles in the environment; such as water purification, flow regulation and water storage, ecosystem balance through biodiversity preservation and conservation, carbon sequestration and water provision.

The importance of and threat to wetlands is manifested in the number of international instruments which govern their preservation and use (Mwakaje, 2009). The Ramsar Convention on Wetlands of 1971, the Rio-de-Janeiro Conference, the Kyoto Protocol of 1995 and the Copenhagen Climate Meeting of 2009 were results of the recognition that global and regional climate changes are a threat to the land resources on which human survival thrives (Rebelo, 2009). They universalized the importance and scope to embrace all aspects of wetland conservation and "wise use" of the more than 1800 wetlands designated as internationally important (Lukas, 2006).

Kenya has insufficient water reserves: recyclable fresh water per capita as of now stands at 647 m3 and is required to tumble to 235 m3 by 2025 if supply will not match up with the populace increment. This circumstance is ascribed to a few elements among them the annihilation of catchment regions through by decimation of forests, stream bank tilling and poor land utilization practices. The outcome has seen expanded run off, torrents, limited infiltration, soil wash offs and siltation of water reservoirs repositories. Moreover, the impacts of unsustainable human and manufacturing practices close expansive water bodies add to the decrease in the natural state of the ecosystem (Saggerson, 1991).

Several studies have been carried out by researchers to assess the state of wetlands in Kenya. One such study is the Wetland Assessment and Monitoring Strategy by NEMA,

2012. NEMA in consultation with other stakeholders around the country initiated a process to develop a Wetland Monitoring and Assessment Strategy for Kenya (WEMASK). The WEMASK provides NEMA and lead agencies with an initial strategy on how to spearhead and sustain a wetland monitoring and assessment scheme using various methods/techniques that are compliant with the existing legislative and regulatory frameworks.

It is obvious from the analyses that Kenya does need a Wetlands Assessment and Monitoring Strategy. This recognition is consistent with the urgency and need for wetland research as stipulated in the Ramsar Convention through Strategy 1.1 of the Strategic Plan 2009-2015, which advocates for description, assessment and monitoring of the degree and state of a wide range of wetlands at significant scales, to advise and support usage of the Tradition, specifically in the utilization of its arrangements concerning the savvy utilization of all wetlands.

Existence of a Wetland Assessment and Monitoring Strategy will not lead to wise use of wetlands rather it is the goodwill and collaboration among various stakeholders. This strategy observes that there are many wetlands stakeholders in Kenya; including different institutions and organizations which possess important information, data, expertise and infrastructure that must be harnessed in an integrated manner to develop a scheme to spearhead more information gathering, storing and sharing to stimulate and ensure wise use of wetlands.

As a signatory to these instruments, Kenya has gradually designated numerous lakes and sites as “Ramsar sites” (Ndaruga, 2009). Regardless of their significance to settlement and agriculture, wetlands are constantly under threat by the over-exploitation of the functions, goods and services. They contribute to livelihoods, and now they face intense pressure (Mwakaje, 2009). Kenya’s Vision 2030 (MPND, 2008) reiterates the significance of agriculture as the mainstay of the economy. The rapid population growth has led to widespread sub-division of original land parcels into agriculturally unviable holdings (Tegemeo, 2006).

With the richness of the soils and moisture content, wetlands have become an easy fallback for land-hungry households and land speculators. Characterized by their shallow, reed lush laden vegetation and easy-to-drain briny water, they are being sapped for agricultural use at a distressing rate (Mwakaje, 2009). This is rapidly turning them into degraded dry lands and rendering them less productive, thus posing the twin hazards of famine and ecosystem obliteration. An all-stakeholder effort is needed to return wetlands to their sustainable value.

1.2 Statement of the Problem

There is growing concern and awareness both at national and international level, that many forms of development activities are causing environmental and natural resource degradation (Flint, 2004). Within the the past 50 years, biological systems have been changed more quickly and expansively than in whatever other time of the earth's existence (MEA, 2005). Besides, it has prompted to an exceptional change of freshwater environments and therefore biodiversity destruction, with over half of the world population formerly in water catchments (MEA, 2005; GWP, 2004a).

Environmental degradation has had devastating effects on natural resources. One major effect is wetland loss and degradation. This sorry state has to a great extent been attributed to human behaviour (Mwakaje, 2009). Such anthropogenic factors include human activities on wetlands. Westlands sub-county in Nairobi County has experienced a fair share of human encroachment on its wetland resources. Residential facilities have been constructed in such areas as Kitisuru, Mountain View, and Kangemi, Parklands and Karura. Further to this, public infrastructure has also been developed on the same (Saggerson, 1991).

It is such activities that have blocked the natural course of water leading to extensive flooding, destruction of infrastructure and pollution due to heavy sedimentation. If not properly mitigated, this situation could accelerate with adverse effects such as water shortage, drought, ecosystem imbalance, habitat fragmentation; and thus worsen the already grave challenge of environmental degradation (Ajibola, 2012).

This study not only focused on the influence of human activities on wetlands, but also how this eventually impacted on the physical environment. In the long run, this will enable the community to understand how their encroachment to wetlands has and continues to result in to detrimental effects to themselves and the biological diversity.

1.3 Purpose of the Study

The purpose of this study was to investigate the influence of human activities on wetlands on the physical environment in Westlands sub-county, in view of proposing viable mitigation measures against the same.

1.4 Objectives of the Study

The objectives of this study were;

i. To establish how agricultural activities on wetlands influence the physical environment in Nairobi County.
ii. To determine how construction of public infrastructure on wetlands influences the physical environment in Nairobi County.
iii. To assess how construction of residential structures on wetlands influences on the physical environment in Nairobi County.

1.5 Research Questions

This study sought to answer the following research questions:

i. How do agricultural activities on wetlands influence the physical environment in Nairobi County?
ii. How does construction of public infrastructure on wetlands influence the physical environment in Nairobi County?
iii. How does construction of residential structures on wetlands influence the physical environment in Nairobi County?

1.6 Significance of the Study

The deteriorating state of wetlands and consequent threats to sustainability of livelihoods remains a matter of concern to several governments, particularly in developing countries. Despite international and national instruments instituted in recent times, there appears to be a widespread misguided judgment that wetlands are non-productive and can in this manner be changed over to different uses, for example, farming, mechanized advancement or residential locations.

According to Dixon and Wood (2003), the misconception, especially amongst developing countries is attributable to inappropriate government policies, population pressure and socio-economic change which exacerbate clamor for more agriculturally-productive land. Populations thus resort to untested land use practices which often neither protect the environment nor adequately meet their basic livelihood and food needs.

This study aimed to elucidate the influence of human activities on wetlands on the physical environment in Nairobi County, a case of Westlands sub-county; hence contributing to the general body of knowledge, and forming a basis for further research on this grave issue and its implications in day to day life.

1.7 Basic Assumptions of the Study

This research made the assumptions that all natural factors that were likely to cause detrimental effects on wetlands were constant; and that none of these factors could eventually influence the effects of wetland degradation on the physical environment.

It was assumed that Nairobi river transverses through all the five constituencies of Westlands sub-county forming a water catchment, that was the basis for the study.

It was also assumed that all the respondents, including the GoK officials would set aside a few minutes and be accessible to make contributions in the research, giving their most genuine and non-biased feedback to the research. Also, it was accepted that assets for auspicious data gathering and examination were readily available.

1.8 Limitations of the Study

The researcher encountered various limitations while seeking access to information for the study. These included reluctancy to giving information by respondents, expecting that the data obtained from them can be used to victimize or threaten them; or potentially print an adverse picture about the part of the executive in promoting wetland loss and degradation. The researcher solved this hindrance by having an introduction letter from the institution of learning, a research permit from the National Commission for Science, Technology and Innovation (NACOSTI) and also guaranteeing them that the data they provided would be treated with privacy and that it would be utilized only for scholastic purposes.

The investigator additionally experienced an issue in requesting data from the participants, as the data required would be subjected to sentimentalism, states of mind, feelings and observations, which couldn't be correctly measured as well as substantiated impartially. The analyst consequently urged the respondents to take an interest without withholding any data they had as the exploration instruments would not reveal their names. The study was also limited in achieving its full objectives due to lack of sufficient funds to carry it out in a wider geographical scope; and the time required by the researcher in carrying out data collection in all the sub-counties in Nairobi County for this study. The researcher however limited the study by focusing on areas in Westlands sub-county only.

1.9 Delimitations of the Study

The study was limited to establishing the influence of human activities on wetlands on the physical environment in Westlands sub-county. Although there were projects carried out by different individuals and organizations on wetland encroachment and degradation in Kenya, the study strictly focused on people residing in Westlands sub-county and those who carrried out agricultural, residential and public infrastructural activities within this sub-county.

Nairobi covers a territory of around 700 km2 at the south-eastern end of Kenya's farming heartland. At 1600m to 1850m above ocean level, it experiences moderate temperatures throughout the year (CBS 2001, Mitullah 2003). The western region of the city is the most noteworthy, with a rough terrain, whereas the eastern part is lower and typically flat

Westlands sub-county is part of Nairobi County, Kenya's capital and largest metropolitan in Kenya (reference Appendix V). Westlands was a private neighborhood in Nairobi city at the pre-independence time, terminating in 1963. Amid the 1990s and mid-2000s, due to scarceness and appreciating value of office rental and land areas, there was more exodus towards Westlands and Upper Hill areas, where there was more space. Westlands was initially regarded as part of Parklands region; and hedged what is presently Waiyaki Way, initially the Kenya-Uganda Railroad.

Westlands sub-county covers around 72.4 km2 at the south-eastern end of one of Kenya's farming heartland. At 1800 to 1850m above ocean level, Westlands experiences moderate temperatures throughout the year (CBS 2001, Mitulla 2003). Westlands is one of the highest altitude areas of Nairobi in regard to altitude however with a rough terrain. The Nairobi and Mathare rivers cut across various neighborhoods of Westlands sub-county and the natural Karura forest covers some areas of Westlands County. Nairobi River is a key stream snaking through Westlands sub-county and has Thigirie, Getathuru, RuiRuaka and Karura tributaries.

1.10 Definition of Significant Terms

Agricultural Activities: These are activities straightforwardly identified with the generation or processing of farm produce, dairy products, poultry, or domesticated animals for starting business deal or as an important method for individual subsistence.In relation to this study, agricultural activities involve the systematic cultivation of the soil and planting of crops for sustenance or economic gain. It is synonymous to farming. Examples of agricultural activities as depicted are upstream irrigation projects and application of agrochemicals for example fertilizers, herbicides, fungicides and pesticides.

Human Activities: These are activities that the community members/ humans are involved in as a means of their survival. In this study, human activities include agricultural activities, construction of public infrastructure and construction of residential structures.

Physical Environment: The external and natural conditions in which one exists. In this study, the physical aspects of the environment are, but not limited to; water resources (rivers, seas, and oceans), soil, air and land cover (forest resources).

Public Infrastructure: This is characterized as the fundamental hardware and structures that are required for a nation, locale or organization to work appropriately. It is the physical capital investments. Examples of public infrastructure in this study are; roads and bridges, water and sewerage systems etc.

Residential Structure: This is defined as a unit designed for people to live in. In this study, it is a unit that provides accommodation in addition to other services. It relates to homes, apartments, or any place where people live.

Wetlands: These are territories where water is the essential variable controlling the earth and related plant and creature life. As per this study, a wetland is a land range that is soaked with water, either for all time or regularly, to such an extent that it goes up against the qualities of an unmistakable biological community. For instance, swamps, bogs, lowlands, and fens; and sub-sorts incorporate mangrove, carr, pocosin, and varzea.

Wetland Conservation: In this study, it is defined as the use of measures and strategies to promote wetlands protection, to maintain its pristine state and control the wetland resources over-exploitation to ensure sustainability.

Wetland Management: According to this study, Wetland Management includes practices that can be led with, in, and around wetlands; both characteristic and man-made, to secure, re-establish, control, or accommodate their capacities and qualities.

1.11 Organization of the Study

This research report is presented in five chapters. Chapter one covers the introduction to the study, which entails the background of the study, statement of the problem, purpose of the study, objectives of the study, research questions, significance of the study, basic assumptions, limitations of the study, delimitations of the study, definition of significant terms used in the study, and the organization of the study.

Chapter two focuses on literature review of the topic, and entails an introduction, in-depth examination and introduction of the various variables with regards to human activities on wetlands and their impact on the physical environment. It also includes a theoretical framework, conceptual framework, highlights of independent variables, dependent variables, as well as the summary of the literature review findings.

Chapter three focuses on research methodology, which constitutes its introduction, research design, target population, sample size and sampling procedure, research instruments, pilot study, validity of the research instruments, reliability of the research instruments, data collection procedure, data analysis, ethical considerations and operationalization of the study variables.

Chapter four of this study focuses on presentation of findings, analysis and interpretation of data collected. This chapter constitutes of its introduction, questionnaire return rate, demographic characteristics of respondents, distribution of respondents by gender, age, level of education, marital status and occupation, as well presentation of data based on the variables used; and inferential statistics.

Finally, chapter five focuses on the summary of findings, discussions, conclusions and recommendations of the study. This entails introduction, summary of the findings which will outline a summary of each variable with regards to their influence on wetlands on the physical environment, discussions, conclusions, recommendations and study contribution to the body of knowledge.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter focuses on literature review, in-depth examination and introduction of the various variables with regards to human activities on wetlands and their impact on the physical environment. It also includes a theoretical framework, conceptual framework, highlights of independent variables and dependent variables, as well as the summary of the literature review findings.

2.2 Agricultural Activities on Wetlands and the Physical Environment

Agricultural activities on wetlands have affected the physical attributes of the environment overtime; these attributes being soil and water quality. Wetlands are among the ecosystems that are most productive due to their attributes. They are essential in the well-being of humans in the context of socio-economic benefits hence their livelihood; and play a critical role in the environment such as water purification, water storage and water flow regulation, ecosystem balance through biodiversity preservation and conservation, carbon sequestration and water provision (Mwakubo et al. 2008).

Wetlands normally offer a wide assortment of advantages to society and they have assumed a focal part in human advancement all through history (The Kenya Land Alliance, 2009). Numerous extraordinary civic establishments relied on upon them, including the Maya, Inca and Aztec in Latin America, the Khmer in Asia, the Swamp Middle Easterners in Mesopotamia and those of the Nile and Niger in Africa. Today, a portion of the world's biggest wetlands are notable. The Okavango Delta in Botswana and the Pantanal in Brazil are renowned for wildlife tourism; the Nile Delta in Egypt, the Ganges Delta in India and Bangladesh, and the Mekong Delta in Vietnam, albeit all intensely adjusted, bolster all inclusive noteworthy farming and also other human practices (Gosselink and Baumann, 1980).

But smaller, less well-known wetlands are likewise colossally critical, going about as a wellspring of nourishment and water for individuals living close-by. For instance, the Ga-Mampa wetland in South Africa is just 0.43 km2, however is a fundamental asset for the encompassing communities. In total these little wetlands assume a noteworthy part in decreasing destitution and supporting both jobs and biodiversity (Allen, 1994)

There is more grounded proof of the part that wetlands play in some third world nation economies. In Zambia, for instance, wetlands are evaluated to contribute around 5% of total national output (Wood et al. 2013a). They regularly bolster the poorest individuals in a locale, so their financial advantages are frequently more huge than a straightforward measure of their commitment to Gross domestic product may suggest. For instance, in Tanzania's Kilombero Valley, wetlands contribute up to 80% of money salary for the poorest families (McCartney et al. 2010). Wetlands additionally address the underlying drivers of destitution, for example, poor sustenance and an absence of clean water.

In Kenya, wetlands are the ranges of land that are once in a while or for all time water logged with new, harsh, saline or marine waters, including both man-made and regular territories that bolster trademark flora and fauna (Masibayi, 2011). These incorporate bogs, swamps, lowlands, shallow lakes, bull bow lakes, dams, riverbanks, floodplains, fishponds, lakeshores and seashores. They additionally incorporate seaside and marine wetlands, for example, deltas, estuaries, mud flats, mangroves, salt swamps, seagrass quaint little inns reefs all of which at low tide ought not surpass 6 meters. These wetlands possess around 3% to 4%, which is roughly 14,000 km2 of the land surface and changes up to 6% in the blustery seasons (Ramsar, 1971).

According to Allen and Debra (1990), as much as dangers differ amongst different areas and also within wetlands, agricultural practices are regarded as more critical. Partially, this is because of the extent of wetland agriculture that has witnessed an immense expansion in recent times and mucked up wetlands worldwide. However, the nature of most wetlands have undergone extensive and non-revesible transformations altered as people attempt to enhance agrarian profitability (Abila, 2005)

The relationship between irrigation farming and its impacts on wetland environ systems has frequently been depicted as one of an immediate tradeoff between the human requirement for nourishment in contrast to nature. The truth, as uncovered by this documented survey, is a great deal more perplexing, as both frameworks human and nature might be versatile (Alwe, 1980). Where nature may adjust consequently, for example, a waterfowl adjusting to paddy rice as a swap for normal wetland environment, people too adjust deliberately. For instance, as people have found out about the significant services wetlands give, the reaction has been to discover approaches to safeguard and reestablish wetlands (Agwata, 2005). This is moderately achievable in the third world nations, which has admittance to reserves and the institutional and legitimate ability to force no loss of wetlands, yet it is a great deal more troublesome in the developed nations where there are squeezing requirements for expanded nourishment generation with the constrained assets accessible (OECD, 1996).

In this study, drainage and reclamation of wetlands is one of the ways in which agricultural activities on wetlands influence the physical environment; the physical aspect being soil. As a result, soil disintegration usually happens taking after change of normal vegetation to horticultural land. At the point when regular vegetation is cleared and farmland furrowed, the uncovered topsoil is frequently overwhelmed by wind or washed away by rain (Ashley, 2000). Soil disintegration influences profitability since it evacuates the surface soils containing a large portion of the natural nutrients, plant supplements, and fine soil particles, which hold water and supplements in the root zone where they are accessible to plants. The sub soils that stay have a tendency to be less prolific, less permeable, and less ready to hold pesticides, composts, and other plant supplements (Baez et al, 1987). Regularly, the transient expenses of executing disintegration control measures far surpass the quick monetary advantage to the farmer, however such money saving advantage investigations neglect to consider the long haul destructions of fruitfulness and water-holding limit of the dirt.

Not just has this affected straightforwardly on wetland biodiversity, pulverization of forests and wetlands has diminished the surge stockpiling limit of the land bringing about expanded flooding. McGranahan et al. (2007) noticed that while monetary action and urban advancement frequently increment the environmental tension that prompt to flooding, it is normally the low pay settlements and poorest gatherings inside the urban settlements that have a tendency to be the most defenceless.

On the other hand, another agricultural activity that influences the physical environment is the use of agrochemicals such as fertilizers and pesticides, which in turn has an effect on the physical environment aspect which is water resources quality. Based on Mwakaje (2009), use of fertilizers results in nutrients being lost from farming fields through spillover, waste, or connection to disintegrated soil particles. The sums lost rely on upon the soil form and natural matter substance, the atmosphere, incline of the land, and profundity to groundwater, and additionally on the sum and kind of compost and water system utilized. The three noteworthy supplements in manures are nitrogen, phosphorus, and potassium. Of these, nitrogen is the most promptly lost due to its high solvency in the nitrate shape. Filtering of nitrate from farming fields can hoist focuses in basic groundwater to levels unsatisfactory for consumption water quality (Crowards, 1996).

Another downside to the expanding pesticide utilize is the improvement of resistance in vermin species. The individual vermin that survive pesticide applications keep on breeding, step by step delivering a populace with more prominent resistance to the chemicals connected. Pesticides in this manner must be utilized as a part of continually expanding amounts or supplanted with new chemicals to enough control bother populaces. Subsequently, these natural compounds are profoundly relentless in the earth and amass in creature tissues, bringing about water sullying, angle executes, and decrease of some feathered creature populaces. Since some of these new pesticides are profoundly dissolvable in water, they may drain to groundwater beneath the agricultural regions and cause water pollution (Rebelo et al, 2009).

2.3 Construction of Public Infrastructure on Wetlands and the Physical Environment

Construction of public infrastructure such as roads and bridges are often constructed across wetlands; thus affecting the physical environment, whose attributes are water quality and air quality. This is because wetlands are inexpensive. It is regularly thought to be more practical to fabricate streets or scaffolds crosswise over wetlands than around them (Winter, 1988). carriage networks can seize a wetland, regardless of the possibility that culverts are utilized. Such unintentional impoundment and hydrologic adjustment can change the elements of the wetlands and thusly increase sedimentation; bringing about influencing the physical environment (Mitsch and Gosselink, 1993).

Subways can likewise upset habitat congruity, pushing out more touchy, local species, and ushering in the hardier sharp edge and exotic species. Streets can obstruct development of specific species or result in expanded deaths for wild animals crossing over. Obtain pits (applied to give fill to street development) that are contiguous wetlands can corrupt water quality through sedimentation and increasing turbidity in the wetland (Irwin 1994).

Developers more often than not construct ommercial facilities without planning on how effluent will be disposed appropriately; hence waste water (raw sewage) is either channeled to a river, or disposed off carelessly. Lack of maintaining sewer line leads to blockage of pipes (Nijkamp, 1989). Areas not served with a sewer line use septic tanks which also poses other risks if not well managed. Some are poorly constructed and others have inadequate water supply hence posing a dangerous health risk to the living organism including man; thus resulting in loss of biodiversity (Zedler, 2005).

Construction works and paved roads also result in additional run off through creation of impervious areas and compaction of soils (Mwakaje, 2009). Impervious areas and compacted soils generally have higher run off coefficients than natural area and increased flood peaks are a common occurrence in developed area. Increased runoff from paved grounds and expansive roofs hence causes extreme flooding and overflows of drainage system.

2.4 Construction of Residential Structures on Wetlands influence the Physical Environment

Construction of residential structures on wetlands is one of the major land use activities that influence the physical aspects of the environment such as water and land cover. Numerous wetland destructions, worlwide, are immediate aftereffect of man's monetary practices. These exercises run from farming, development, water redirection and a large group of others (Ajibola et al, 2012). MEA (2005) expressed that the debasement and loss of inland wetlands and species has been driven by structural improvement, (for example, lodging, reservoirs, dykes, and levees), change of land usages, water withdrawals, contamination, overharvesting, and the presentation of obtrusive outsider species.

In USA, Wetland destruction in the lower Mississippi delta have been the matter of escalated examinations as far back as the extent of wetland destruction issue and its potential budgetary and social impacts were at first seen (Gosselink and Baumann, 1980; Gagliano, Myer-Arendt, and Wicker, 1981). Really a few reports have been recorded about the complex physical and biogeochemical frames and their interdependencies that are responsible for wetland annihilation (Day et al., 2000 and Penland et al., 2000). Despite the tremendous number of prior studies, there are still disputations and unsettled inquiries with respect to the essential significance of normal versus initiated ecological changes that have brought about the latest dramatic destructions in wetlands (RoK, 2002).

Degeneration of inland wetlands through land improvement and water administration decreases the limit of wetlands to give noteworthy biological system administrations. Human practices expected to decrease harm to life and properties from atmosphere extremes have accidentally expanded the susceptibility of wetlands by modifying the regular hydrologic elements of wetlands (Ramsar, 2009). Urbanization may influence wetlands on the scene level, through loss of broad regions, at the wetland complex level, through waste or adjustment of a portion of the units in a gathering of firmly divided

wetlands, and at the level of the individual wetland, through change or fracture (Weller, 1988).

As a result, large amounts of solid wastes are usually generated during construction and operational phase. This will include metal cuttings, rejected materials, excavated materials, paper bags, empty cartons, broken glass among other materials from the construction site. During the operational phase of construction, there is usually massive generation of wastes from the community which pollutes water (UNCBD, 2010).

2.5 Theoretical Framework

In this study, the theoretical framework used was Integrated Water Resource Management Theory, which was vital in establishing how human activities on wetlands influence the physical environment, and the corresponding mitigation measures.

2.5.1 Integrated Water Resource Management Theory

Integrated Water Resources Management (IWRM) can be portrayed as the planned progression and organization of water, land, and related resources for enhance the consequent money related and social welfare in a fair-minded path without exchanging off the supportability of critical natural ecosystems (Roy, Jane, and Venema, 2011). This theory was advanced by UNEP-DHI Center for Water and Environment and popularized by the Dublin standards received at an International Conference in Dublin in 1992. It elevates a participatory way to deal with incorporated asset administration on a watershed premise and advances the acknowledgment of the financial advantages of overseeing water and related assets.

IWRM is one type of the ecosystem approach as a method for the corporate use of land, water, and domesticated animals that advances protection and maintainable use in a fair way (MEA, 2005). Ecosystems are alert edifices of plant, creature, and microorganism groups and their nonliving surroundings, communicating as a utilitarian unit. Ecosystems fluctuate massively in size, and can run from microorganisms to substantial global sea bowls (Roy et al., 2011). As indicated by the Convention on Biological Diversity (1992),

the ecosystem approach is a methodology for the incorporated administration of land, water and living assets that advances protection and reasonable use in a fair way. IWRM, as portrayed by the Global Water Partnership, highlights the association of characteristic and social frameworks and gives a useful structure to such mix on a watershed premise.

Zedler (2008) clarifies that the biological system approach in watersheds depends on the idea that water, biodiversity, and natural security require building up interdisciplinary, between sectoral and between institutional activities. He takes note of that these activities characterize methodologies for activities and speculations in view of the necessities and needs of watershed tenants. The IWRM theory can be applied to ameliorate the current environmental degradation problem in Nairobi River. Inter- disciplinary and inter-sectoral coordination is necessary for the proper management of the Nairobi River ecosystem. Community participation in the project is also necessary to ensure its success. This would lead to the maximization of the resultant financial and social wellbeing in a fair manner. According to Roy et al. (2011) the strengths and weaknesses of the theory are as follows:

The strengths depicted by the IWRM Theory is that it takes note of the financial advantages of controlling water related assets in a unified way through the provision of high level of ecosystem services. It is an important Climate Change Adaptation Strategy (Intergovernmental Panel on Climate Change) that ultimately provides extra social and monetary advantages, including neighborhood jobs and lightening destitution inside waterway basins.

On the other hand, the IWRM Theory has certain weaknesses such as its implementation, which is costly as it requires a substantial investment in both institutional framework and infrastructure; which can be overwhelming for developing countries. Furthermore, IWRM Theory's inter-sectoral integration may be hampered by differing sector specific goals.

2.6 Conceptual Framework

In this study, it was conceptualized that the predictor variables would impact the outcome variable. The conceptual framework shows the influence of human activities on wetlands on the physical environment in Nairobi County, a case of Westlands sub-county. These factors; agricultural activities, construction of public infrastructure and construction of

residential structures have affected wetlands hence the physical environment. This is depicted by the diagram below.

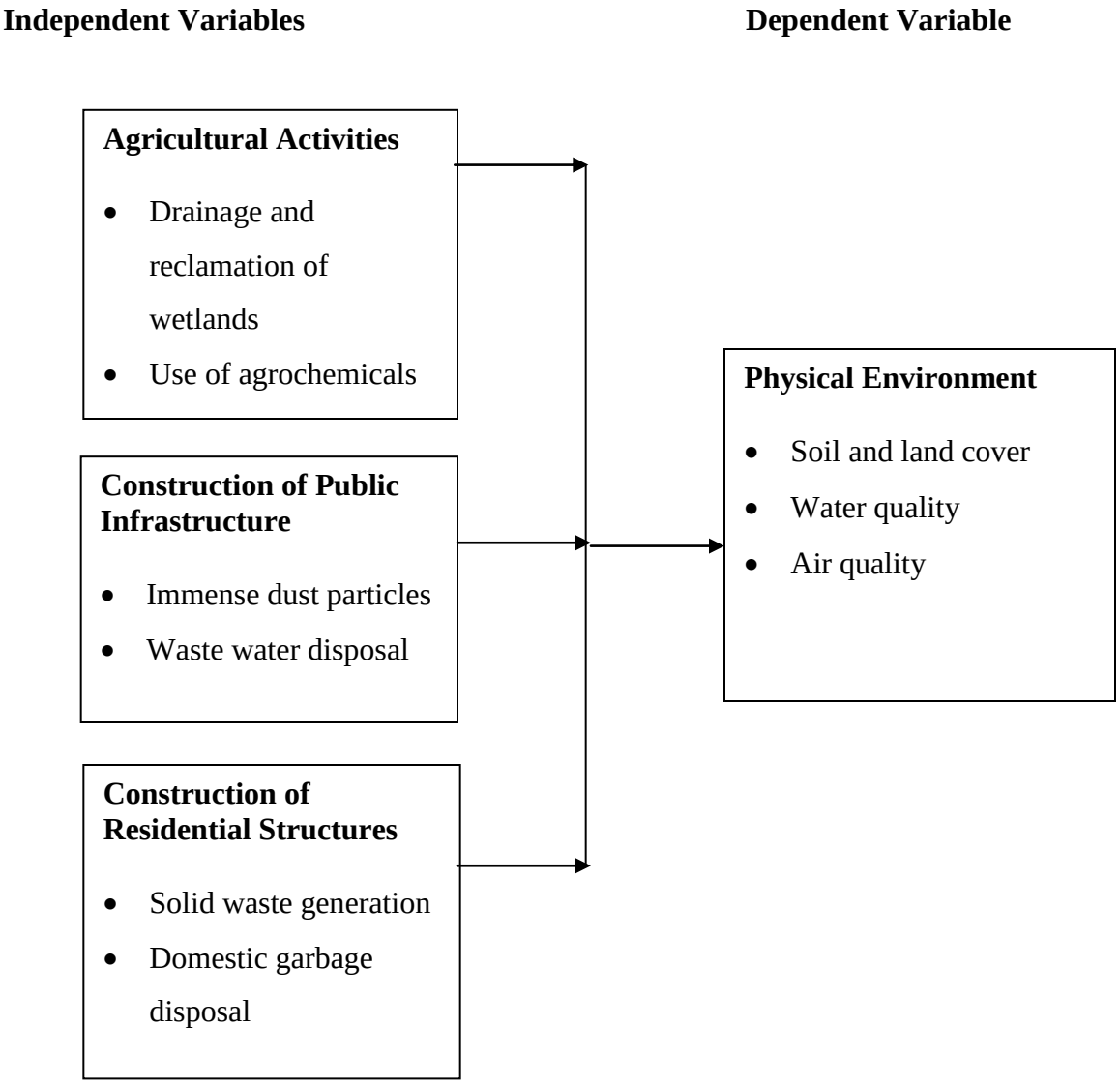

Figure 1: Conceptual Framework

Wetlands offer a scope of assets, however there are cut-off points to the degree to which they can be economically utilized. Effective revenue generation practices may demonstrate unsustainable if a wetland is too little to sustain the surrounding populace, or if an excessive number of individuals relocate towards a wetland to profit by its potential (Mwakaje, 2009).

Wetland debasement by people and poverty can without much of a stretch get to be recurrent: as wetlands are adjusted, the utlities they give are lost, pushing individuals promote into destitution, which thus prompts to further corruption. The Millenium Ecosystem Assessment (2005) anticipated that if wetland destruction and degeneration proceeded with, it would bring about further decreases in human prosperity, particularly for destitute individuals.

In this study, agricultural activities on wetlands such as land reclamation and conversion of wetlands to agricultural land has led to soil erosion, thereby influencing the physical aspect of the environment which is land cover. Moreover, according to Abila (2005), the use of agrochemicals such as fertilizers and pesticides also influences the physical environment attribute which is water resource, and eventually cause water pollution.

Construction of public infrastructure on wetlands, such as roads and bridges, influences air quality by polluting it. This is attributed to the fact that there is dust produced immensely during and after the construction activities such as drilling and excavation exercises using large scale machinery. There is also the development of sewerage systems, which conveys waste water that in turn causes water pollution by being dumped in the wetland ecosystem (Winter, 1988).

As a result of construction of residential structures on wetlands, there is solid waste generation especially from the unused building materials; which in turn influences the physical environment by blocking drainage pipes, and causing eventually flash floods. Residents also end up disposing their garbage in the wetlands, and as a result cause water

pollution. This garbage disposal such as bottles, plastics and metal cuttings block drainage pipes and in turn results in flooding (Weller, 1988).

2.7 Summary of Study Gaps

Research has been conducted on anthropogenic factors causing wetland degradation, protection and conservation policies, but none has been conducted on how these anthropogenic factors on wetlands influence the physical environment. The table below shows a summary of the study gaps.

Table 2.1: Selected literature and identified gaps

AUTHOR (S)	OBJECTIVE	SETTING	RESEARCH GAP
1.NEMA (2012)	To develop wetland assessment and monitoring strategy for Kenya.	Kenya	The study focused on coming up with a strategy for wetlands assessment and monitoring. This study focused on how human activities on wetlands have influenced the physical environment.
2. Draft National Wetlands Conservation and Management Policy (2013)	To ensure wise use and sustainable management of wetlands.	Kenya	The study was on the measures that should be taken to ensure wetlands conservation and management. This study on the other hand focused on the influence of human activities on wetlands on the physical environment.

3. Hagos Gebresllassie, Temesgen Gashaw and Abraham Mehari	To summarize the threats/challenges of Ethiopian wetlands	Ethiopia	The study was a summary of the threats, consequences and strategies to wetland degradation. This study was solely on how anthropogenic factors on wetlands influence the physical environment in Nairobi county.

2.8 Summary of the Reviewed Literature

It is evident that there is a huge problem of wetland encroachment by humans, and this eventually results in environmental degradation. Agricultural activities, that is land reclamation and conversion of wetlands to productive, agricultural land, as well as use of pesticides and fertilizers immensely affect the physical environment by inflicting damage to water and the land cover. This eventually results in land degradation (Abila, 2005).

On the other hand, construction of public infrastructure on wetlands also poses a huge threat to the physical environment by causing air pollution by dust through the tedious exercises such as drilling and clearing land for building; and also waste water from the sewerage systems being disposed off in the wetland causing water pollution and posing a risk to the biological species (Winter, 1988).

Construction of residential structures on wetlands influences the physical environment by generation of immense solid wastes such as metal cuttings and unused building materials. These materials are in turn disposed off in the wetland, causing blockage of drainage pipes and eventually flash floods. There is also domestic garbage disposal from the residents to the wetland, resulting in water pollution (Weller, 1988).

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the introduction, research design, target population of the study, sampling size and sampling procedure, research instruments, pilot study, validity and reliability of research instruments, data collection procedure that was used as well as data analysis, ethical considerations and operationalization of the study variables.

3.2 Research Design

This research adopted descriptive survey which was aimed at collecting both quantitative and subjective information to give an extraordinary profundity of reactions bringing about a superior and expand comprehension of the phenomenon under investigation. The advantage of this design is that it is usually used extensively to describe behaviour, attitude, characteristic and values and also used to portray the universally handy normal for the study populace; and demonstrate the relationship between the outcome and predictor variables (Brink and Wood, 1998).

This sort of research design is fitting in depicting and depicting attributes of an occasion, circumstance, a gathering of individuals, group or a populace. It prompts to the profile improvement of a circumstance or community of individuals by securing complete and potentially exact data (Mugenda and Mugenda, 2003). In this study, a structured inquiry was critical in deducing personal, social and economic characteristics of informants. Data on various characteristics such as the age group and job description led to the development of a profile on the group of informants.

As indicated by Brink and Wood (1998), a survey design might be used to study attributes in a populace to explore likely arrangements of an exploration issue. In this study, the study configuration was utilized to explore the learning levels of the nearby inhabitants on how their activities influence the surrounding wetland resources; with a specific end goal to see whether absence of their insight thereof, might lead to this critical resource's degradation (Churchill, 1979).

This design is impartial and therefore there is no preference in the choice of units incorporated in in the exploration. The research information, thusly is gathered in the normal setting and in a brief span, using questionnaires, interviews and/ or observation (Brink and Wood 1998:103).

3.3 Target Population

A population refers to the total collection of elements about which the analyst wishes to make a few inferences (Cooper and Schindler 2003). The research populace in an investigative study about contains each one of those potential members that could make up a research population (Kothari, 2004). In this research, the populace of Westlands sub-county was 176,689 people according to the last Kenya National Bureau of Statistics 2009 census.

Table 3.1: Westlands Sub-County Population

No.	Name	Population (2009 National Census)	Area (Sq. Km)	Percentage Composition (%)
1	Kitisuru	31,202	21.30	17.7%
2	Parklands/ Highridge	38,344	8.20	21.7%
3	Karura	26,453	38.20	15.0%
4	Kangemi	44,564	1.60	25.2%
5	Mountain View	36,126	3.10	20.4%
Total		**176,689**		**100%**

Source: Kenya National Bureau of Statistics (KNBS), 2009

The target population is "the entire aggregation of respondents that meet the designated set of criteria" (Burns and Grove 1997:236). In order to achieve the objectives of this study, the target population consisted of county government agencies in charge of environmental conservation and wetland management; which were 3 Environmental Officers from NEMA and 2 Pysical Planners from Ministry of Devolution and Planning; and the

residents of Westlands sub-county who encroach on the water catchment in various ways like residential development, farming and public infrastructural development.

3.4 Sample Size and Sampling Procedure

3.4.1 Sample size

The minimum sample size n will be obtained using the formula developed by Cochrane (2006) will be used in populations that are large:

Where:

n = minimum sample size to be estimated

Z = critical value of the standard normal distribution for the 95% confidence interval around the true population (1.96)

P = Proportion in the target population estimated to have similar characteristic, in this case P is 89.4 % (in this case P is 89.4 % which is the estimated proportion of human activities that influence physical environment; study by Mirongo, 2005)

E=margin of error. Since the assumed proportion is 89.4, the allowable margin of error is 5

$$n = \frac{Z^2 P (100- P)}{E^2}$$

$$= \frac{1.96^2 * 89.4(100-89.4)}{5^2}$$

= 145.6

10% non-response rate

$$= \frac{10 * 145.6}{100} = 14.6$$

= 14.6 + 145.6

= 160.2

This study comprised of 160 respondents. It is assumed that 160 is the measure of the proportion of residents in Westlands sub-county that are engaged in the human activities that influence the physical environment. This study adopted simple random sampling

whereby each member of the subset had an equal probability of being chosen. The sample selected was 28 respondents from Kitisuru, 35 respondents from Parklands/ Highridge, 24 respondents from Karura, 40 respondents from Kangemi and 33 respondents from Mountain View constituencies. This sample was based on the proportion of the population each constituency had; See Table 3.1- Percentages Column.

3.4.2 Sampling Procedure

Purposive sampling is a method generally utilized as a part of subjective research for the ID and selection of information rich cases for the best use of confined resources (Patton, 2002). This incorporates perceiving and selecting individuals or social occasions of individuals that are especially taught about or experienced with a wonder of interest (Cresswell and Plano Clark 2011). In this case, knowledge on wetland degradation, and with specific reference to Westlands sub-county, which encompasses five wards namely: Kitisuru, Highridge/ Parklands, Karura, Kangemi and Mountain View within the greater Nairobi County. Notwithstanding learning and experience, Bernard (2002) and Spradley (1979) take note of the essentialness of availability and energy to share, and the ability to pass on experiences and notions in a clear, expressive and insightful way.

Purposive sampling was particularly utilized to identify the county government entities in relation to wetland management. The two key institutions were National Environment and Management Authority and Ministry of Devolution and Planning.

Subsequently, the study investigated the local residents who live or have constructed residential and public infrastructure, and/or practice agricultural activities on/ along the wetland, their ideology and understanding of the water catchment area, its benefits and how its eventual degradation would impact on their lives. The area of interest in this study was around the tributaries which were assumed to pass through all the five constituencies of Westlands Sub-County to form a water catchment zone; therefore the need to interview people from all these constituencies.

Since Kombo and Trump (2006) prescribe that for such little populace, all things be concentrated so that every one of their reactions are considered in the investigation, these

people were arbitrarily chosen to guarantee that sufficient information was gathered for the examination.

3.5 Research Instruments

Primary data was collected in this research especially through surveys and direct communication with the respondents. The methods used included;
Key Informant Interview guide, Appendix II: This was essential in establishing the response of the key informants, NEMA and Ministry of Devolution and Planning, on the influence of human activities on the wetland ecosystem, uses of wetlands and conservation measures towards the wetland management.

Questionnaires: Researcher assisted questionnaires were used to include the level of awareness of the sample population on wetland use. The questionnaires contained several questions on the influence of human activities on wetlands on the physical environment and were administered to the selected respondents so that there was time to explain the purpose of the study and the meaning of the questions if they were not clear to the respondents. A structured questionnaire, Appendix III, with both open-ended and closed-ended questions was administered to the respondents.

Observation: An observation schedule, Appendix IV, was used to measure the overt behaviour of persons and the environment and it covered the subjects to be observed which were; the influence of human activities on wetlands on the physical environment, the date of observation and recording of observed changes which included the physical changes within the environment.

The sources provided data on stakeholders, threats, degradation trends and management options currently available in the wetland and the environmental stress factors. The study made utilization of existing data, including distributed and unpublished information. The information was acquired from writing survey on important library material, prior research diaries, periodicals, the media and the Web. Finding the sources and recovering the data of such information was regarded a decent beginning stage to set up what has as of now been done and to what degree.

3.6 Pilot Study

A pilot study is done to test the validity and reliability of the research instruments. As indicated by Mugenda (2008), pilot testing entails undertaking a preparatory trial of information gathering apparatuses and techniques to recognize and take out issues, permitting projects to make restorative amendments to instruments and data accumulation strategies.

To familiarize with the data collection procedures, the researcher carried out a pilot test study in Athi River. This is because it is an area where Sabaki River transverses forming a water catchment. Identifying the exact number of participants in a pilot group is a challenging affair, but as a rule of thumb, it is advisable for researchers to pilot at least 10-20% of the final sample (Baker, 1994). 15% of the final sample 160 respondents, was 24 respondents. The researcher administered the pilot survey personally and individually to a small group of the final respondents. As a result of the pilot study, the researcher incorporated few improvements including re-sequencing and re-phrasing to the final questionnaire. The pilot study tested for reliability and validity of the data collection tools.

3.7 Validity of the Research Instrument

Validity of a research instrument, as per Joppe (2000), is the degree to which the instrument really measures what it was proposed to quantify. Golafshani (2003), states that validity of a research tool is controlled by whether the method for estimation are exact, thorough, dependable and ensure quality. In this research, the validity of the exploration instruments was resolved through the delineation of variables being calculated and improvement of key inquiries that are targeting each of the predictor variables.

Triangulations were utilized to close the research inadequacies left by the data gathering tool and strategies. This was attained through desk surveys and personal questionnaires. Content legitimacy means to figure out whether the substance of the instrument is

sufficiently satisfactory to gauge what the scientist plans to quantify. This was resolved through subjecting the instruments through expert moderation, which is the research moderator from the University of Nairobi.

3.8 Reliability of the Research Instrument

Reliability is a measure of the extent a research tool provides predictable results or information after frequent trials. Reliability in research is impacted by randomness of error. As these random errors increase, reliability goes down. Random errors is the deviation from the true estimation because of the elements that have not adequately been tended to by the investigator Joppe, 2000).

In connection to this study, the split-half procedure of testing reliability was adopted. This technique requires just a single testing session. Under this method, an instrument was tailored in a manner to give two sections. Subjects' scores from one section were corresponded with scores from the second section. Information with a high split-half reliability will have a significant correlation coefficient. Because we are correlating a portion of the test scores with the other a large portion of, the coefficient so registered does not mirror the reliability of the entire instrument. A correlation variable is in this way connected on the registered coefficient. The adjusted coefficient speaks to the unwavering quality of the entire test. This redress is done utilizing the Spearman-Brown prophecy equation.

$$\mathrm{Re} = \frac{2r}{1+r} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad \textbf{Equation}$$

Where r = estimated correlation between two halves

Whereby; $Re = \underline{2\ (0.732)}$

$1 + 0.732$

Re= **0.85**

The questionnaires were considered reliable if the value for Re was 0.80 or more. Increasing the number of items in the instrument increases the chances of obtaining a consistent estimate of the reliability of the data. Therefore from the above calculation whereby Re was 0.85> 0.80, it was denoted that the questionnaires developed were reliable and hence the researcher went ahead to administer them to the respondents.

3.9 Data Collection Procedure

The researcher interviewed 5 county government officials 3 from NEMA and 2 from Ministry of Devolution and planning. This was done through an interactive manner whereby questions were asked and filled by the questioner in an eye to eye circumstance with the interviewee.

The researcher obtained an introductory letter from the university, as well as a research permit from National Commission for Science, Technology and Innovation as required. The letters were issued to the respondents, in order to show valid proof of the research work. The questionnaires were then distributed on a face to face basis in order to gather data for the study.

The questionnaires were administered by the researcher and two field assistants to the respondents. Once the period given to fill in the questionnaires elapsed, the researcher finally collected the questionnaires and collated them for analysis. The researcher visited all the five constituencies and observed the physical aspects of the environment, and noted them down. Such aspects were; soil and land cover, water quality and air quality.

3.10 Data Analysis

The questionnaire for data collection had the following main categories of information: bio data, social economic activities of the respondents, wetland management and utilization, changes within the wetlands and the physical environment. Threats to the wetlands, conservation and sustainable ways of their utilization also formed part of the data. Where necessary, non-parametric data to be collected will first be standardized. Responses were standardized by using a standard scale of 1 to 5, where variables were numbered 1 = 5 scores, 2 = 4 scores, 3 = 3 scores, 4 = 2 scores, and 5 = 1 score.

The gathered information was then very much analysed and checked for culmination and fathom ability. Thereafter, it was condensed, coded and tabulating. Data cleaning was then done and tabulated. The tabulated information was examined with the assistance of the Statistical Package for Social Sciences (SPSS 20.0) that has information taking care of and statistical investigation capacity that can break down statistics and produce descriptive analysis (Norusis, 2007).

In order to conduct inferential statistics, the study used multiple linear regression equations, and the method of estimation was an Ordinary Least Squares (OLS) to develop a link between human activities and physical environment in Westlands sub-county. Correlation analysis and ANOVA was used to describe the degree to which one variable relates to the other. The study adopted the following regression model to determine the relationship between variables;
From the regression model:

$$\mathbf{Y = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 + \varepsilon}$$

Where:

Y= Physical environment

X_1 = Agricultural activities

X_2 = Construction of public infrastructure

X_3 = Construction of residential structures

Data presentation was accomplished by the utilization of percentages and frequency tables. The main objective for the presentation of information was to outline the outcomes and to make information or outcomes more illustrative by depicting them as figures and tables making it easier to make an observation on the general patterns. The information was then broke down utilizing descriptive design which incorporates frequencies, percentiles, means and standard deviations. Subjective data on the other hand was presented using verbatim statements.

3.11 Ethical Considerations

Research ethics alludes to the relevance of the investigator's conduct in connection to the rights of the respondents, and research undertaking. (Trochim, 2006). In this research, the principle of wilful involvement was guaranteed through acquiring interviewee assent of the dangers and advantages of the exploration. This was to guarantee that respondents were not forced or hoodwinked into taking part in the study; and that they understood that there would be no compensation obtained for giving information. The researcher respected and observed secrecy for each of the respondents through non-disclosure of characters and information from respondents to some different people.

3.12. Operationalization of the Study Variables

The table below shows the operational definition of the study variables.

Table 3.2. Operationalization of the Study Variables

Objectives	**Variables**	**Indicators**	**Measurement Scale**	**Data Collection Tools**	**Analysis Technique**
To establish the influence of agricultural activities on the physical environment in Nairobi County, A case of wetlands	Agricultural activities Physical environment	Land reclamation and conversion of wetlands Use of agrochemicals	Ratio Ordinal	Questionnaires Interviews Observation	Mean Standard deviation Frequency tables Correlation analysis
To establish the influence of construction of public infrastructure	Construction of public infrastructure	Immense dust particles Waste water disposal	Ratio Ordinal	Questionnaires Interviews Observation	Mean Standard deviation Frequency

on the physical environment in Nairobi County, A case of wetlands	Physical environment				tables Correlation analysis
To assess the influence of construction of residential structures on the physical environment in Nairobi County, A case of wetlands	Construction of residential structures Physical environment	Solid waste generation Domestic garbage disposal	Ratio Ordinal	Questionnaires Interviews Observation	Mean Standard deviation Frequency tables Correlation analysis

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND INTERPRETATION OF FINDINGS

4.1 Introduction

This chapter deals with data analysis, presentation and interpretation of the findings of the study upon which conclusions were made. The findings were presented in form of frequency tables. These findings were discussed with a view to generating logical conclusions in response to the stated study objectives as appropriate. Household characteristics such as gender, age, level of education, marital status and respondent's occupation; and variables such as human activities on wetlands that is, agricultural activities, construction of public infrastructure and construction of residential structures were discussed.

4.2 Questionnaire Return Rate

The study targeted a total of 160 respondents on the influence of human activities on wetlands on the physical environment in Westlands sub-county. Out of the 160 questionnaires issued, 145 were returned giving a 91% response rate as shown in Table 4.1. As indicated by Mugenda and Mugenda (2003), a 50% feedback rate is sufficient, 60% is great and more than 70% is appraised as great. In view of these attestations, this suggests the reaction rate for this study, 91% is great hence I went ahead with the study because it was viable. The data was collected from residents of Westlands area that formed the water catchment area, and hence whose activities were in turn encroaching on the wetland area.

Table 4.1 Questionnaire Response Rate

Response	Questionnaires administered	Questionnaires filled and returned	Percentage
Total	**160**	**145**	**90.625**

4.3 Demographic Characteristics of the Respondents

The study sought to establish the demographic information in order to evaluate the influence of human activities on wetlands on the physical environment in Nairobi County; a case of Westlands sub-county. The demographic information comprised of gender, age, level of education, marital status and occupation.

4.3.1 Distribution of respondents by gender

The researcher sought to determine the gender distribution of the respondents.

Table 4.2: Gender of respondents

Gender	**Frequency**	**Percentage**
Male	80	55
Female	65	45
Total	**145**	**100**

The findings of the study as shown in table 4.2 indicate that majority of the respondents who participated in the study were male and accounted for 55%, while the female counterparts accounted for 45%. Male were more involved in the study because they did not shy away from being part of the study whose outcome would be used to salvage the wetland. This kind of disparity was not expected to bring any difference to the study as it was not the main area of concern by the research.

4.3.2 Distribution of respondents by age

The researcher sought to determine the age category of the respondents.

Table 4.3: Age of respondents

Age	Frequency	Percentage
Under 18	7	5
19-29	29	20
30-39	51	40
40-49	36	20
Over 50	22	15
Total	**145**	**100**

The results as shown in table 4.3 above show that 5% of the respondents were under 18 years, 20% of the respondents were between the ages 19-29 years, 40% of the respondents were between the ages of 30-39 years while 20% of the respondents were between the ages of 40-49 years. 15% of the respondents were over 50 years. These discoveries uncover the respondents matured between 30-39 years were the greater part. This proposes they could comprehend and recognize the issue at hand, which is wetland encroachment and eventual degradation of the physical environment. It can also be observed from the findings of the study that most of the respondents who participated in this research are the youth as stated in the constitution, from age 18-39. This could be explained by the literate state of most young people who could read, understand and answer the questionnaires presented to them.

4.3.3 Distribution of respondents by level of education

The study also found it of importance to determine the participants' level of education which is crucial for this study as the respondents' level of education eliminates the bias of uneducated respondents.

Table 4.4: Level of Education of respondents

Level of Education	Frequency	Percentage
Primary	-	-
Secondary	7	5
College	48	33
University	90	62
Total	**145**	**100**

According to table 4.4, the findings indicate that 62% of the participants were university degree holders, 33% of the participants had a college certification and 5% of the participants had only a secondary certification. Since many of the participants (62%) had university degrees, an assumption was made that a significant percentage of the participants had reasonable education to execute the roles assigned to them effectively and efficiently, enabling them make prudent decisions.

4.3.4 Distribution of respondents by marital status

The marriage status of the participants was used to determine whether it positively and adversely impacted their demeanour and view towards wetlands conservation and management.

Table 4.5: Marital Status of respondents

Marital Status	Frequency	Percentage
Married	63	43
Single	31	21
Separated	37	26
Widowed	14	10
Total	**145**	**100**

The findings in table 4.5 reveal that 43% of the respondents were married, 21% of the participants were not married and 26% of the participants were separated while 10% of the participants were widowed. This indicates that many of the respondents were in a marriage relation and they were the individuals who were much likely to provide information on issues surrounding wetland degradation and management issues.

4.3.5 Distribution of respondents by occupation

The study sought information on the respondents' livelihood activities or economic occupation.

Table 4.6: Occupation of respondents

Marital Status	Frequency	Percentage
Farmer	31	21
Business man/ woman	54	37
Construction worker	37	26
Civil servant	15	10
Others	08	06
Total	**145**	**100**

The findings in table 4.6 indicate that 21% of the respondents were farmers, 37% of the respondents were business men/women, 26% of the respondents were construction workers while 10% of the respondents were civil servants. 06% of the respondents on the other hand were not on the category of occupations mentioned. This shows that majority of the respondents understood the study being carried out and would in turn give adequate information on how human activities on wetlands influence the physical environment.

4.4 Agricultural Activities on Wetlands and the Physical Environment

This section basically needed to assess how agricultural activities carried out on wetlands influence the physical environment in Westlands sub-county. The indicators for this

variable were deforestation to clear land for the farming practices, soil erosion and the use of agrochemicals.

4.4.1 Land reclamation, conversion of wetlands and loss of land cover

The respondents were asked their opinion on land reclamation causing loss of land cover; and the extent to which they agreed or not to this statement.

Table 4.7: Land reclamation and loss of land cover

Response	Frequency	Percentage
Strongly Agree	67	46
Agree	40	28
Neutral	20	14
Disagree	10	07
Strongly Disagree	08	05
Total	**145**	**100**

The findings in table 4.7 reveal that majority of the respondents, 46% strongly agreed to the fact that land reclamation and conversion of wetlands to agricultural land has led to rapid soil erosion and hence eventual loss of land cover in the area thus degrading the physical environment; and 28% agreed to the same. 14% of the respondents were neutral, which could mean that they did not fully understand the phenomenon under study; and 07% and 05% of the respondents disagreed and strongly disagreed to this statement respectively.

4.4.2 Agrochemicals and water pollution

The respondents were asked their opinion on whether use of agrochemicals resulted in water pollution; and the extent to which they agreed or not to this statement.

Table 4.8: Agrochemicals and water pollution

Response	Frequency	Percentage
Strongly Agree	84	58
Agree	45	31
Neutral	10	07
Disagree	06	04
Strongly Disagree	-	-
Total	**145**	**100**

According to table 4.8, the findings reveal that majority of the respondents were of the opinion that agrochemicals such as pesticides and fertilizers are rampantly used by farmers in areas where they practice agricultural activities. This in turn has led to water pollution and thus wetland degradation. 58% strongly agreed to this statement and 31% agreed to the same. 07% of the respondents were neutral, 04% of the respondents dissented with this assertion; and 00% of the respondents unequivocally dissented with this assertion

4.4.3 Agriculture and sustainable wetland utilization

The respondents were asked their opinion on whether there was a possibility of carrying out agricultural activities around the wetland area without inflicting damage to the wetland resources; and the extent to which they agreed or not to this statement.

Table 4.9: Agriculture and sustainable wetland utilization

Response	Frequency	Percentage
Strongly Agree	72	50
Agree	42	29
Neutral	12	08
Disagree	10	07
Strongly Disagree	09	06
Total	**145**	**100**

The findings according to table 4.9 reveal that majority of the respondents, 50%, strongly agreed to sustainable utilization of wetlands for agricultural activities and 29% agreed to the same. 08% of the respondents were neutral, 07% of the respondents dissented with this assertion; and 06% of the respondents unequivocally dissented with this assertionAccording to these findings, it was interpreted that most of the respondents were of the opinion that wetlands could be utilized sustainably for agricultural purposes without depleting the resource base. This is because population in the region has increased overtime, and the wetland is an important resource for their livelihood.

4.5 Construction of Public Infrastructure within Wetlands and the Physical Environment

The study sought to determine whether the respondents were involved in, or were aware of construction of public infrastructure within the wetland area, and to what extent.

4.5.1 Immense dust particles and air pollution

The respondents were asked their opinion on whether the construction of public infrastructure within the wetland caused immense dust particles to be released in the atmosphere; and the extent to which they agreed or not to this statement.

Table 4.10: Immense dust particles and air pollution

Response	Frequency	Percentage
Strongly Agree	68	47
Agree	56	39
Neutral	16	11
Disagree	05	03
Strongly Disagree	-	-
Total	**145**	**100**

The findings in table 4.10 reveal that majority of the respondents the respondents were of the opinion that during construction of public infrastructure such as roads and bridges, immense dust particles are released into the atmosphere the heavy machinery used; for example during drilling exercises, resulting into air pollution. 47%, strongly agreed to this and 39% agreed to the same. 11% of the respondents were neutral, 03% of the respondents dissented with this assertion; and 00% of the respondents unequivocally dissented with this assertion

4.5.2 Waste water disposal and water pollution

The respondents were asked their opinion on whether waste water from sewerage systems resulted in water pollution; and the extent to which they agreed or not to this statement.

Table 4.11: Waste water disposal and water pollution

Response	Frequency	Percentage
Strongly Agree	39	27
Agree	37	26
Neutral	35	24
Disagree	20	14
Strongly Disagree	12	09
Total	**145**	**100**

The findings in table 4.11 reveal that majority of the respondents were of the opinion that waste water from the sewerage systems was disposed off within the wetland, causing hazardous effect to water by polluting it. 27% strongly agreed to this statement and 26% agreed to the same. 24% of the respondents were neutral, 14% of the respondents dissented with this assertion; and 09% of the respondents unequivocally dissented with this assertionAccording to these findings, it was interpreted that most of

4.5.3 Construction of public infrastructure and sustainable wetland utilization

The respondents were asked their opinion on whether there was a possibility of constructing public infrastructure sustainably; and the extent to which they agreed to this statement or not.

Table 4.12: Construction of public infrastructure and sustainable wetland utilization

Response	Frequency	Percentage
Strongly Agree	41	28
Agree	40	28
Neutral	30	21
Disagree	19	13
Strongly Disagree	15	10
Total	**145**	**100**

The findings in table 4.12 reveal that most of the respondents were of the opinion that wetlands could be utilized sustainably during construction of public infrastructure without depleting the resource base. This is because such infrastructure as sewerage systems, roads and bridges are vital to their everyday lives. 28% strongly agreed to this statement and 28% agreed to the same. 21% of the respondents were neutral, 13% of the respondents dissented with this assertion; and 10% of the respondents unequivocally dissented with this assertion

4.6 Construction of Residential Structures within wetlands and the Physical Environment

The study sought to determine whether the respondents were aware of construction of residential structure within the wetland.

4.6.1 Solid waste generation and blockage of drainage pipes

The respondents were asked their opinion on whether the construction of residential structures resulted in generation of solid wastes; and the extent to which they agreed or not to this statement.

Table 4.13: Solid waste generation and blockage of drainage pipes

Response	Frequency	Percentage
Strongly Agree	61	42
Agree	49	34
Neutral	27	19
Disagree	08	05
Strongly Disagree	-	-
Total	**145**	**100**

The findings according to table 4.13 reveal that majority of the respondents were of the opinion that construction of residential houses results in generation of large amounts of solid wastes such as metal cuttings, excavated materials and unused building materials. This in turn leads to blockage of drainage pipes and eventual flooding. 42%, strongly agreed to this statement and 34% agreed to the same. 19% of the respondents were neutral, 05% of the respondents disagreed with this assertion; and 00% of the respondents unequivocally dissented with this assertion

4.6.2 Domestic garbage disposal and water pollution

The respondents were asked their opinion on whether there was domestic garbage disposal within the catchment area that caused water pollution; and the extent to which they agreed or not to this statement.

Table 4.14: Domestic garbage disposal and water pollution

Response	Frequency	Percentage
Strongly Agree	57	39
Agree	46	32
Neutral	19	13
Disagree	18	12
Strongly Disagree	05	04
Total	**145**	**100**

The findings according to table 4.14 reveal that majority of the respondents the respondents were of the opinion that during the operational phase, there is domestic garbage disposal such as domestic waste water, plastics and bottles within the wetland that causes rampant water pollution. 39%, strongly agreed to this statement and 32% agreed to the same. 13% of the respondents were neutral, 12% of the participants dissented this proposition; and 04% of the participants unequivocally dissented this proposition.

4.6.3 Construction of residential structures and sustainable wetland utilization

The respondents were asked their opinion on whether there was a possibility of constructing residential houses sustainably; and the extent to which they agreed or not to this statement.

Table 4.15: Construction of residential structures and sustainable wetland utilization

Response	Frequency	Percentage
Strongly Agree	49	34
Agree	48	33
Neutral	32	22
Disagree	09	06
Strongly Disagree	07	05
Total	**145**	**100**

The findings according to table 4.15 reveal that most of the respondents were of the opinion that residential structures could be constructed around the wetland area, by following all environmental regulations and hence ensuring sustainability. 34%, strongly agreed to this statement and 33% agreed to the same. 22% of the respondents were neutral, 06% of the respondents dissented with this proposition; and 05% of the respondents unequivocally dissented with the proposition.

In the interviews carried out by the researcher, NEMA and Ministry of Devolution and Planning were mentioned as agencies which have failed to provide monitoring units to authorize any access to the wetlands. Both the interviews established from the key informants that no monitoring agencies were effective in controlling the misuse of the wetland resource, yet NEMA is charged with the responsibility of implementing all policies relating to environment in the country. When asked if the water catchment was being used in a sustainable manner, most of the informants indicated that unsustainable practices were being conducted within the water catchment, such as the current uncontrolled human activities which pose a threat to the wetland.

On the other hand, observations of the state of the physical environment denoted that water quality in this wetland was of the worst state. This is because of the visible algae in the

water, and also the brackish colour which denotes waste water disposal. Furthermore, there were also glasses, bottles and polythene bags disposed off in the water. Soil and land cover was also largely affected because of the visible gulleys. Air was affected but basically during the excavation and drilling process, where dust particles were visible in the atmosphere. This shows that all these human activities on wetlands influence the physical environment by causing degradation and eventual loss of biodiversity.

4.7 Inferential Statistics

The researcher sought to find out the description of the variables by use of averages and standard deviations in describing the relationship between variables as in the table below.

Table 4.16: Descriptive Statistics

	N	Mean	Standard Deviation
Physical environment	144	3.0147	.78691
Agricultural activities	144	4.1678	.43511
Construction of public infrastructure	144	4.8661	.39042
Construction of residential structures	144	4.3247	.32510

The data findings analysed in table 4.16 above show 144 interpretations which were used in the study. The mean and standard deviation for the dependent variable (Physical environment) was 3.01 and 0.787 respectively. The mean score for construction of public infrastructure was 4.87 with a standard deviation of 0.39, construction of residential structures had a mean score of 4.32 and a standard deviation of 0.33 and agricultural activities had a mean score of 4.17 and standard deviation of 0.43. This shows that among the three independent variables, construction of public infrastructure and construction of residential structures are the strongest factors in regard to the influence of human activities on wetlands on the physical environment in Westlands sub-county.

4.7.1 Correlation Analysis

Spearman correlation was used in the study to scrutinize the influence of human activities on wetlands on the physical environment in Westlands sub-county.

Table 4.17: Correlation Analysis

Spearman Correlation	Physical environment	Agricultural activities	Construction of public infrastructure	Construction of residential structures
Physical environment	1			
Agricultural activities	0.577**	1		
Construction of public infrastructure	.366*	.313*	1	
Construction of residential structures	.354*	.243*	.267*	1

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

The data findings analysed in table 4.17 above show a solid direct correlation amongst agricultural activities and physical environment with a correlation of 0.577. This indicates that sustainable agricultural practices within the wetlands can significantly positively influence the physical environment.

The data findings analysed also reveal a strong positive correlation between construction of public infrastructure and physical environment as indicated by a correlation of 0.366. This infers that appropriate construction of public infrastructure by taking into attention planning aspects can result to a better and well conserved physical environment.

The findings show a strong positive significant correlation between construction of residential structures and the physical environment with a correlation of 0.354. This implies that proper designing of residential structures significantly results to a better physical environment.

4.7.2 Regression Analysis

Coefficient of determination discloses the degree to which variations in the outcome variable can be clarified by the adjustment in the autonomous factors or the rate of variety in the outcome variable, physical environment, that is clarified by all the three predictor variables; Agricultural activities, Construction of public infrastructure and Construction of residential structures.

Table 4.18: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.732[a]	.536	.503	3.95751

a. Predictors: (Constant), Agricultural activities, Construction of public infrastructure and Construction of residential structures

From the table 4.18 above, the R square is given as 0. 536 which is an indication that predictor variables (Agricultural activities, Construction of public infrastructure and Construction of residential structures) explicate 53.6% of physical environment leaving 46.4 percent unexplained.

Table 4.19: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	995.997	9	248.999	15.898	.000[b]
	Residual	861.403	135	15.662		
	Total	1857.400	144			

a. Dependent Variable: Physical environment

b. Predictors: (Constant), Agricultural activities, Construction of public infrastructure and Construction of residential structures

From table 4.19 above, the significant value P=0.000 shows that there was a strong significant relationship between the independent variables, Agricultural activities, Construction of public infrastructure and Construction of residential structures; and the dependent variable, Physical environment. The P- value of 0.000 which is less than 0.05 denotes that the model of Physical environment is significant at the 5 percent significance level.

Table 4.20: Coefficients Distribution

Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
		B	**Std. Error**	**Beta**		
1	(Constant)	3.783	3.750		1.009	.317
	Agricultural activities	1.308	.248	.525	2.982	.004
	Construction of public infrastructure	.739	.283	.468	4.615	.000
	Construction of residential structures	.319	.363	.087	.879	.383

a. Dependent Variable: Physical environment

From the regression model:

$$\mathbf{Y = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 + \varepsilon}$$

Where:

Y= Physical environment

X_1 = Agricultural activities

X_2 = Construction of public infrastructure

X_3 = Construction of residential structures

The regression equation is presented below.

$Y = 3.783 + 1.308X_1 + 0.739\ X_2 + 0.319\ X_3$

The equation above concludes that physical environment was extremely swayed by Agricultural activities, Construction of public infrastructure and Construction of residential structures. Given all the predictor variables constant at zero (0), physical environment will be 3.783.

The regression coefficient for agricultural activities is 1.308. This shows that the relationship between agricultural activities and physical environment is positive. This suggests that better and efficient agricultural practices enhance physical environment positively and vice versa.

The regression coefficient for construction of public infrastructure is 0.739. This means that the relationship between construction of public infrastructure and physical environment is positive. This indicates that proper construction of public infrastructure leads to improvement in the physical environment and vice versa.

There was also a positive regression coefficient for construction of residential structures having a coefficient of 0.319. This implies that when the viability of construction of residential structures is high, there is always a more positive impact on the physical environment and vice versa.

CHAPTER FIVE
SUMMARY OF FINDINGS, DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This section summarizes the outcomes, deliberations, conclusions and suggestions in light of the examination carried out in the previous chapter. Moreover, it lays down the inputs of the research to the library of information and recommendations for future research.

5.2 Summary of Findings

This part provides a contraction of the outcomes as the previous chapter outlined.

5.2.1 Socio-demographic characteristics of the respondents

In regard to demographic attributes, the research attempted in establishing the participants` level of comprehension and recognition of wetland encroachment and its influence on the physical environment. The outcomes demonstrate that there were a larger number of men than ladies who took part in the study as prove by 55% of male respondents and 45% of female respondents. Majority of the respondents (40%) fell in the ages of 30-39 years and minority were less than 18 years old years (05%). On level of training, it was discovered that the lion's share of the respondents (62%) were university graduates, (33%) were of college level and (5%) were of secondary level. None of the respondents was below secondary level of education. This means that the respondents had sensible training ability to execute the parts relegated to them adequately and proficiently, empowering them to settle on reasonable choices. Out of the total respondents, 43% were married couples, with 37% of the respondents were business men/ women.

5.2.2 Agricultural activities on wetlands and the physical environment

In view of the objective one which tried to set up the impact of agricultural activities on wetlands on the physical environment, majority of the respondents (74%) agreed that land reclamation and conversion of wetlands to agricultural land resulted in rapid soil erosion and loss of land cover; whereas 14% disagreed with this. 14% were of no opinion to the same. With regards to use of agrochemicals, 89% of the respondents agreed that farmers

around the water catchment used pesticides and fertilizers that resulted in water pollution. Only 11% of the respondents dissented with this assertion. 79% of the respondents were of the opinion that wetlands could be utilized sustainably for agricultural purposes without depleting the resource base, whereas 13% disagreed with this statement and 08% were neutral.

5.2.3 Construction of public infrastructure on wetlands and the physical environment

In relation to second objective which made effort to establishing the effect of construction of public infrastructure on wetlands on the physical environment, most of the respondents (86%) were of the opinion that during construction of public infrastructure such as roads and bridges, immense dust particles are released into the atmosphere the heavy machinery used; for example during drilling exercises, resulting into air pollution. Only 3% of the respondents dissented with this assertion, and 11% were neutral. It was revealed that majority of the respondents 53%, were of the opinion that waste water from sewerage systems was disposed off in the wetland causing water pollution; whereas 23% disagreed with this statement. 24% of the respondents were neutral on the same. Majority of the respondents (56%) were of the opinion that wetlands could be utilized sustainably during construction of public infrastructure without depleting the resource base. This is because such infrastructure as sewerage systems, roads and bridges are vital to their everyday lives. 23% of the respondents disagreed whereas 21% were neutral.

5.2.4 Construction of residential structures on wetlands and the physical environment

Regarding the third objective that sought to determine the influence of constructing residential structures on wetlands, on the physical environment, it was eminent from the number of residents that there were residential structures built within the wetland area. It was revealed that most of the respondents (76%) were of the opinion that construction of residential houses resulted in generation of large amounts of solid wastes such as metal cuttings, excavated materials and unused building materials. This in turn led to blockage of pipes and as a result flooding. Only 5% disagreed with this statement and 19% were neutral. It was revealed that 71% of the respondents were of the opinion that during the operational phase, there is domestic garbage disposal such as plastics and bottles within

the wetland eventually causing rampant water pollution. Only 16% disagreed with this statement whereas 13% were neutral. Regarding construction of residential structures and sustainable wetland utilization, it was revealed that most of the respondents (67%) agreed that residential structures could be constructed around the wetland area, by following all environmental regulations and hence ensuring sustainability; 11% disagreed and 32% were neutral.

5.3 Discussions of the findings

This section outlines the discussions of the findings.

5.3.1 Agricultural activities and the physical environment

According to the findings of this study, the physical environment faces quite a number of challenges as a result of human activities on wetlands. Such are agricultural activities on wetlands. The respondents reported that deforestation is one of these activities. As a result, soil erosion normally happens taking after transformation of common vegetation to farming land. At the point when common vegetation is cleared and farmland furrowed, the uncovered topsoil is frequently overwhelmed by wind or washed away by rain (Ashley, 2000). Land reclamation and conversion of wetlands to agricultural land results to soil erosion, which influences productivity since it erodes the top soils containing the vast majority of the organic material, plant supplements, and fine soil particles, which hold water and supplements in the root zone where they are accessible to plants. On the other hand, according to most respondents, another agricultural activity that influences the physical environment is the use of agrochemicals such as fertilizers and pesticides, which in turn has an effect on the physical environment aspect which is water resources quality by polluting it. The use of fertilizers results in nutrients being lost from farming lands through overflow, waste, or connection to dissolved soil particles (Mwakaje, 2009).

5.3.2 Construction of public infrastructure and the physical environment

According to objective two, most of the respondents were of the opinion that construction of public infrastructure largely affected the physical environment. Roads and bridges are often constructed across wetlands. Roads can encroach on a wetland, regardless of the possibility that culverts are utilized. Such coincidental impoundment and hydrologic

modification can change the elements of the wetland (Winter, 1988). Streets and extensions development practices can build dregs stacking to wetlands, blocking drainage pipes and eventually resulting into floods (Mitsch and Gosselink, 1993). Borrow pits (utilized to give fill for road development) that are nearby wetlands can debase water quality through sedimentation and increment turbidity in the wetland (Irwin, 1994). Developers more often than not construct commercial facilities without planning on how effluent will be disposed appropriately; hence waste water, raw sewage, is either channeled to a river, or disposed off carelessly. Lack of maintaining sewer line leads to blockage of pipes (Nijkamp, 1989). Areas not served with a sewer line use septic tanks which also poses other risks if not well managed. Some are poorly constructed and others have inadequate water supply hence posing a dangerous health risk to the living organisms including man; thus resulting in water pollution (Zedler, 2005).

5.3.3 Construction of residential structures and the physical environment

According to the findings on objective three, it was evident from most respondents' opinions that construction of residential structures within the wetland area influenced the physical environment. Large amounts of solid wastes are usually generated during construction and operational phase. This will include metal cuttings, rejected materials, excavated materials, paper bags, empty cartons, broken glass among other materials from the construction site. This in turn results in blockage of pipes and eventually causing flooding (UNCBD, 2010). During operational phase, there is rapid domestic garbage disposal by the residents to the wetland such as plastics and bottles and this results to pollution of water.

5.4 Conclusions

In conclusion, agricultural activities on wetlands in Westlands sub-county have detrimental effects to the physical environment. This is due to the fact that farmers require to clear land for agricultural practices, and as a result of land reclamation, there is rapid soil erosion and loss of land cover. Another main factor is the use of agrochemicals which pollutes the ground water. However, due to the dire need of farmers to provide for their livelihood, wetlands could be used sustainably for agricultural purposes without depleting the resource base.

When it comes to construction of public infrastructure such as sewerage systems and roads and bridges, these activities also influence the physical environment negatively. For example, during drilling, immense dust particles are released into the atmosphere by the heavy machinery causing air pollution. Construction works and paved roads also result in surface run-off, which in turn causes blockage in drainage pipes and eventual flooding. Waste water from the sewerage systems is also disposed off in the wetland causing water pollution. However, this wetland could still be utilized sustainably without depleting the resource base since public infrastructural development is vital to their daily lives.

With regards to construction of residential structures on wetlands on the physical environment, it is evident that there is generation of solid wastes such as metal cuttings which end up degrading the environment which end up blocking drainage pipes and causing floods. The residents of this area dispose domestic garbage in the wetland causing water pollution. It is however important to note that the population of residents within this wetland area has increased over time, therefore the pressure to find settlement. With proper implementation of the national laws and policies on the environment and physical planning, construction of residential structures can be carried out within the wetland sustainably without depleting the wetland resources and in turn degrading the physical environment.

5.5 Recommendations of the Study

The findings of this study revealed that human activities on wetlands influencing the physical environment are agricultural activities, construction of public infrastructure and construction of residential structures. With the inevitability of wetland cultivation, this study concludes that that land-use activities account for the most important source of livelihoods in the wetlands. This has resulted in the depletion of tree and other vegetation cover, enhanced cultivation and anthropogenic and other human socio-economic activities. Paradoxically the livelihood activities account for the greater damage to the wetlands integrity. The remedies are to be found in the application of a coordinated enforcement of controlled use, participatory planning and management of the natural resources,

exploration and promotion of alternative livelihoods, planting of wetland-friendly crops, and review of the policy on County Government extension support services to farmers.

There should be dredging of the wetland to remove marshes and compacted solid wastes within it shall ensure that the catchment retains its pristine state and increases its capacity. Solid waste management should be developed with much emphasis on the 3Rs; Recycle, Re-use and Reduce, to ensure that the waste does not contaminate the wetland. It is also envisaged to create employment.

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

The research also recommends the government should prioritize the implementation of policy and laws while integrating the community in the implementation process. The government may also designate the wetland as a Ramsar site in order to concentrate efforts to conserve it. Strategic litigation would also go a long way towards sensitization of the masses, enforcing the fundamental right enshrined in the Constitution on the right to a clean and healthy environment.

Community outreach and education program among the various stakeholders in order to enhance increased awareness and knowledge on the importance of wetlands and the impacts of residential developments on them. Training and public sensitization is fundamental to make responsibility and uplifting states of mind towards preservation and practical usage of wetland assets. NEMA and the various NGOs can sensitize local communities on wetland management since they are closer and can associate well with the local people.

5.6 Suggestions for Further Research

This study focused on the influence of human activities on wetlands on the physical environment. From the research, it was realised that there is a lapse in the policy process

right from formulation to implementation. Residential structures are constructed within the wetlands and this is increasing overtime. It is at this point the further research should be carried out on the influence of corruption on wetland conservation and management.

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APPENDICES

APPENDIX I: LETTER OF INTRODUCTION

LAVEEN .M. SAFARY,

P.O. BOX 29053-00625,

NAIROBI.

Dear (Respondent),

I am a post graduate student at the University of Nairobi undertaking a research project on, **"THE INFLUENCE OF HUMAN ACTIVITIES ON WETLANDS ON THE PHYSICAL ENVIRONMENT IN NAIROBI COUNTY: A CASE OF WESTLANDS SUB-COUNTY".**

Your household has been selected for this study and you have been selected to fill the questionnaire. Kindly respond to the questions in the attached questionnaire. The information provided will exclusively and solely be used for academic purposes and will be treated with the confidence it deserves. Upon request, you may be issued with a copy of the final report.

Your cooperation will be highly appreciated.

Yours Faithfully,

Laveen. M. Safary

APPENDIX II: INTERVIEW GUIDE FOR KEY INFORMANTS

NAME OF INSTITUTION: _____

DEPARTMENT: _____

LOCATION: _____

NAME OF OFFICER IN CHARGE: _____

DESIGNATION OF THE OFFICER: _____

1. What are the wetland services/ functions in Nairobi County, Westlands sub-county? Please name them.

2. Are you aware of any human activities carried out on these wetlands?

3. Kindly mention the human activities carried out on these wetlands (as mentioned in question no.2 above)?

4. How do these human activities influence the physical environment in Nairobi County, with specific reference to Westlands Sub-county?

5. What are the conservation measures are put in place to protect the wetlands?

6. How can wetland use co-exist with the livelihood activities to achieve wetland conservation and management?

THANK YOU FOR YOUR TIME AND PARTICIPATION

APPENDIX III: QUESTIONNAIRE

INTRODUCTION

Kindly fill in the questions below to the best of your knowledge. I am assuring you that the responses you give will be kept confidential. Your willingness to participate in this research is highly appreciated.

A: SOCIO-DEMOGRAPHIC INFORMATION

Please tick (✓) the box that matches your answer to the questions and give the answers in the spaces provided as appropriate. The information you provide will be treated with utmost confidentiality.

1. Please indicate your gender

Male ☐

Female ☐

2. Please indicate your age _____

3. What is your highest level of education? (Please choose from these options).

Primary Level ☐

Secondary level ☐

Post- Secondary level ☐

Other (specify) _____

4. What is your marital status? (Please tick one)

Married ☐

Single ☐

Separated ☐

Widowed ☐

5. What is your occupation?

Farmer ☐

Business man/ woman ☐

Construction worker ☐

Civil servant ☐

Others _____

B: HOW AGRICULTURAL ACTIVITIES ON WETLANDS INFLUENCE THE PHYSICAL ENVIRONMENT

6. Are you involved in or are you aware of agricultural activities carried out within this wetland area? Please tick the correct response.

{ } Yes

{ } No

7. Indicate your opinion about the statements depicting the influence of agricultural practices on the physical environment using the scale below. Use a tick.

1= Strongly Agree; 2= Agree; 3= Neutral; 4= Disagree; 5= Strongly Disagree

	1	2	3	4	5
Land reclamation and conversion of wetlands to agricultural land has led to rapid soil erosion and hence loss of land cover in this region.					
Use of agrochemicals such as pesticides and fertilizers also pollute the water catchment.					
The wetland can be utilized sustainably for agricultural purposes without depleting the resource base.					

C: HOW CONSTRUCTION OF PUBLIC INFRASTRUCTURE ON WETLANDS INFLUENCE THE PHYSICAL ENVIRONMENT

8. Are you involved in or are you aware of any public infrastructural activities carried out within this wetland area? Please tick the correct response.

{ } Yes

{ } No

9. Indicate your opinion about the statements depicting the influence of construction of public infrastructure on the physical environment using the scale below. Use a tick.

1= Strongly Agree; 2= Agree; 3= Neutral; 4= Disagree; 5= Strongly Disagree

	1	2	3	4	5
During construction of roads and bridges, there are immense dust particles released by the heavy machinery used, for example during drilling, hence air pollution.					
Waste water from the sewerage systems is disposed off in the wetland causing water pollution					
The wetland can be utilized sustainably for development of public infrastructure without depleting the resource base					

D: HOW CONSTRUCTION OF RESIDENTIAL STRUCTURES ON WETLANDS INFLUENCE THE PHYSICAL ENVIRONMENT

10. Are you involved in or are you aware of any public infrastructural activities carried out within this wetland area? Please tick the correct response.

{ } Yes

{ } No

11. Indicate your opinion about the following statements depicting the influence of construction of residential structures on the physical environment using the scale below. Use a tick.

1= Strongly Agree; 2= Agree; 3= Neutral; 4= Disagree; 5= Strongly Disagree

	1	2	3	4	5
Construction of residential houses leads to generation of large amounts of solid wastes such as metal cuttings, excavated materials, unused building materials etc, which in turn blocks drainage pipes leading to flooding.					
During the operational phase, there is domestic garbage disposal such as plastics and bottles within the wetland that in turn pollutes the water.					
The wetland can be utilized sustainably for construction of residential structures without depleting the resource base					

Kindly use the space below for any additional information.

_____

_____

_____

_____

THANK YOU FOR YOUR TIME AND PARTICIPATION

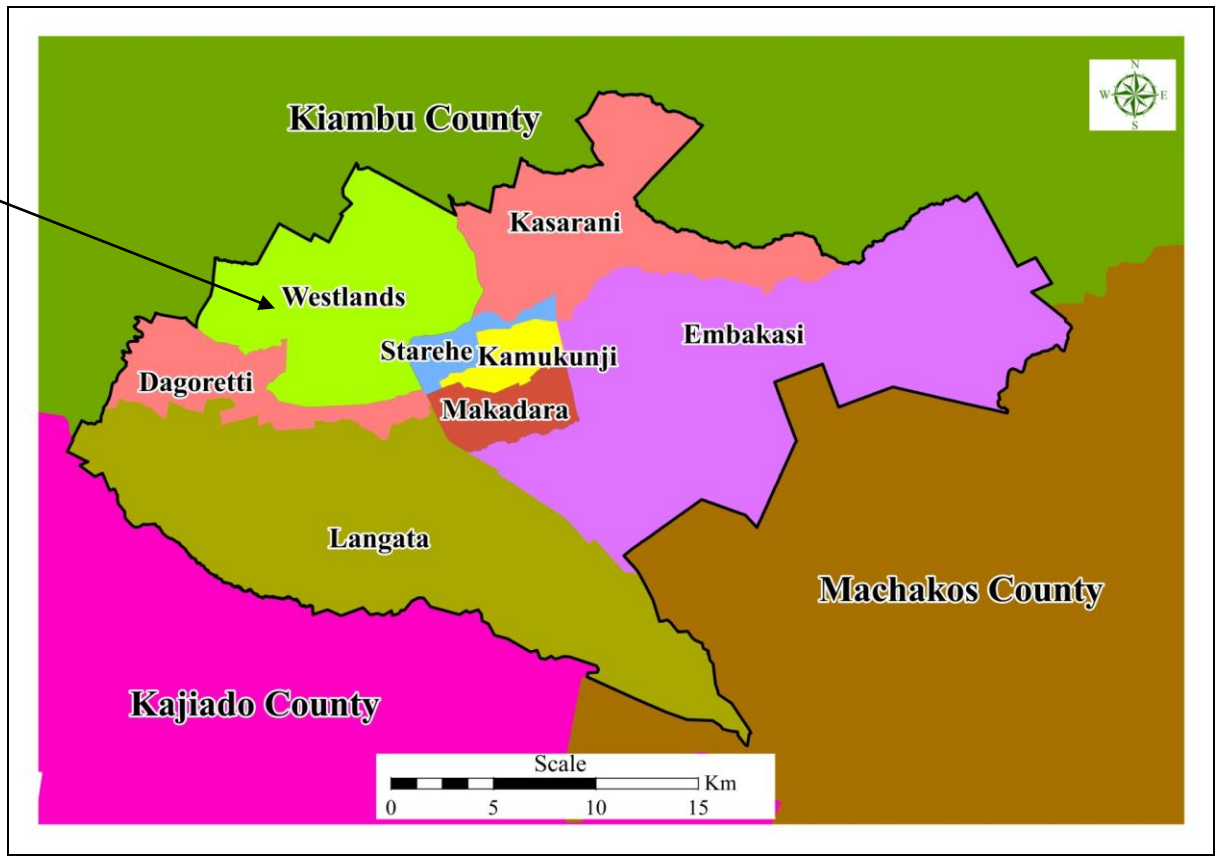
APPENDIX IV: OBSERVATION SCHEDULE

Location:

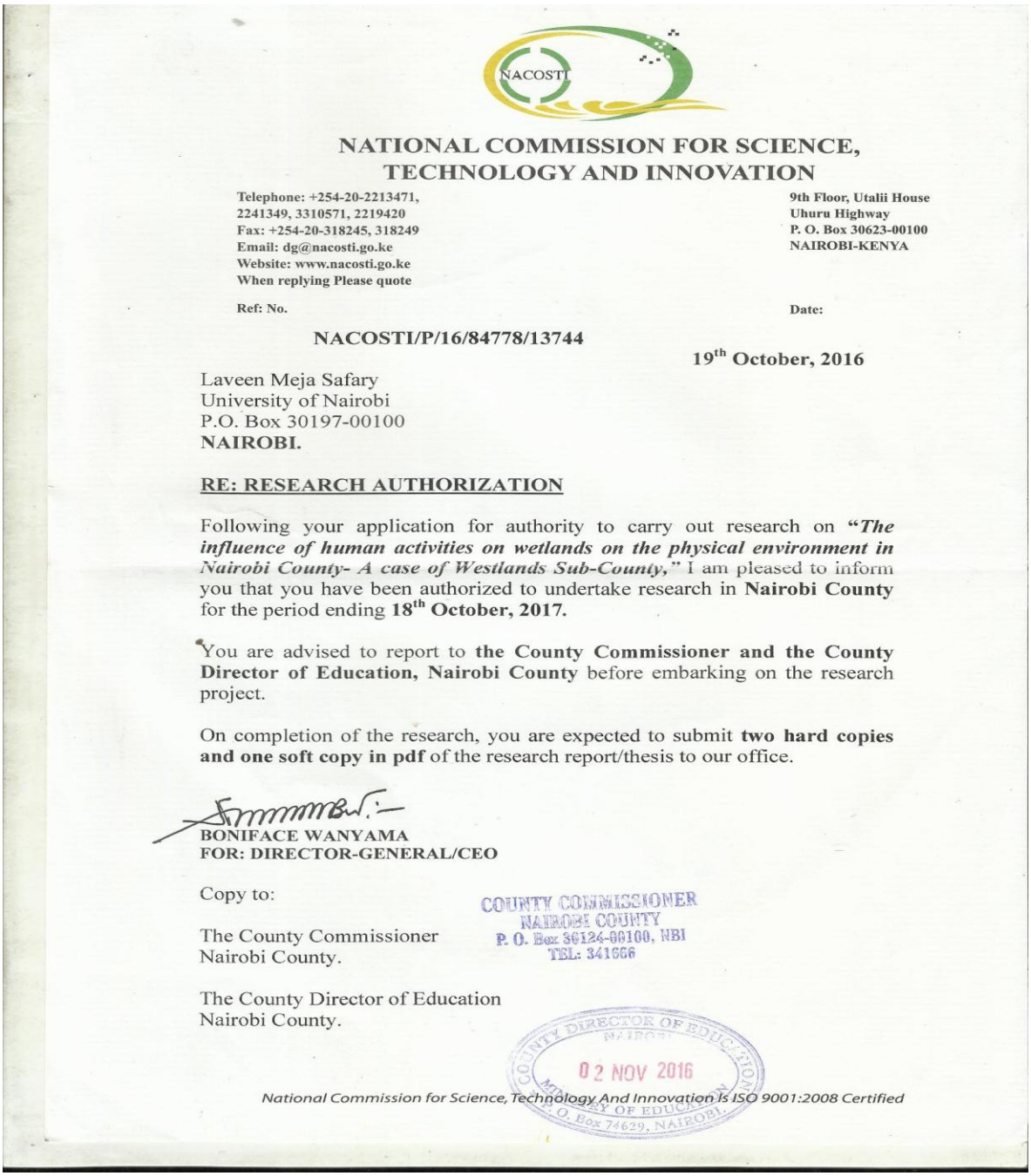
Date of Observation:

Physical aspect of the environment	**State of the physical environment**	**Positive or Negative (+ or -)**
Soil erosion	Presence of gulleys/ excavated land	
Loss of land cover	Loss of vegetation/ bare land	
Water pollution	Presence of bottles, plastic and metal cuttings in the water Presence of greenish sludge/ algae in the water Presence of soil particles in water due to sedimenation	
Air pollution	Presence of dust particles suspended in the atmosphere	

APPENDIX V: MAP SHOWING WESTLANDS SUB-COUNTY



APPENDIX VI: RESEARCH CLEARANCE PERMIT



NACOSTI

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

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P. O. Box 30623-00100
NAIROBI-KENYA

Ref: No. NACOSTI/P/16/84778/13744

Date: 19th October, 2016

Laveen Meja Safary
University of Nairobi
P.O. Box 30197-00100
NAIROBI.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"The influence of human activities on wetlands on the physical environment in Nairobi County- A case of Westlands Sub-County,"*** I am pleased to inform you that you have been authorized to undertake research in **Nairobi County** for the period ending **18th October, 2017.**

You are advised to report to **the County Commissioner and the County Director of Education, Nairobi County** before embarking on the research project.

On completion of the research, you are expected to submit **two hard copies and one soft copy in pdf** of the research report/thesis to our office.

BONIFACE WANYAMA
FOR: DIRECTOR-GENERAL/CEO

Copy to:

The County Commissioner
Nairobi County.

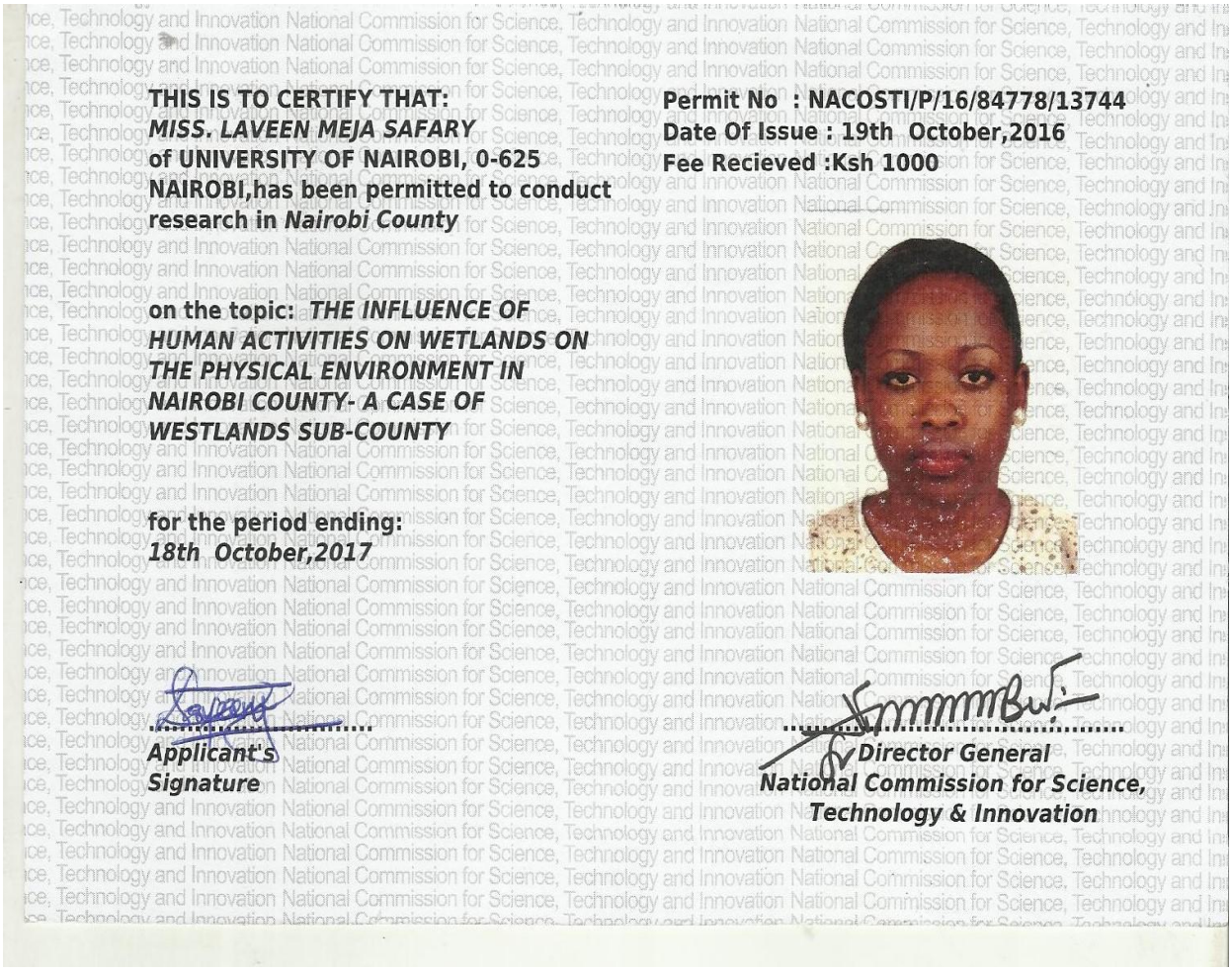
COUNTY COMMISSIONER
NAIROBI COUNTY
P. O. Box 30124-00100, NBI
TEL: 341666

The County Director of Education
Nairobi County.

COUNTY DIRECTOR OF EDUCATION NAIROBI
02 NOV 2016
MINISTRY OF EDUCATION P. O. Box 74629, NAIROBI

National Commission for Science, Technology And Innovation Is ISO 9001:2008 Certified

APPENDIX VII: RESEARCH CERTIFICATE



THIS IS TO CERTIFY THAT:
MISS. LAVEEN MEJA SAFARY
of UNIVERSITY OF NAIROBI, 0-625
NAIROBI,has been permitted to conduct
research in *Nairobi County*

on the topic: *THE INFLUENCE OF HUMAN ACTIVITIES ON WETLANDS ON THE PHYSICAL ENVIRONMENT IN NAIROBI COUNTY- A CASE OF WESTLANDS SUB-COUNTY*

for the period ending:
18th October,2017

Permit No : NACOSTI/P/16/84778/13744
Date Of Issue : 19th October,2016
Fee Recieved :Ksh 1000

.....
Applicant's Signature

.....
Director General
National Commission for Science, Technology & Innovation